Economic evidence of the impact of the Dutch disease's predictions on key labour market outcomes in resource-rich countries

a case study of Nigeria

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By

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Declaration

I, Moustapha Doukoure, certify that all the material in this thesis, submitted for the Doctor of Philosophy degree, from the Department of International Development of King's College London University, is my original work unless specifically acknowledged and/or referenced. Further, no material from this thesis has previously been submitted and/or approved for any other degree to any other academic institutions.

Moustapha Doukoure

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To my God:

> *"I know that all things are working for my good, You are intentional and never failing. I can always smile because I know You are working for my good. Through the hurt and the pain, I know You were and are working for my good"*

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Abstract

The Dutch Disease framework emerged as a key mechanism through which resource revenue impacts the economy within the larger body literature on the “natural resource curse”. On the one hand, it is a dynamic economic adjustment from one equilibrium to another with higher real consumption wages, owing to the fall in import prices from the inflow of resource revenue. However, on the other, this adjustment often results in reduced investment in productive activities and human capital development, in favour of counterproductive activities such as rent-seeking behaviour and possible corruption; thus, it is a source of concern of many policymakers.

Building on the empirical work on Dutch Disease (DD) which presents relatively mixed evidence, this thesis aims to investigate an area of the literature that has received less attention, namely the impact of the DD framework predictions on labour market outcomes, such as the employment level and wages, within a resource-rich developing country. For the purpose of this analysis, the case of Nigeria was selected as the country showcases some of the issues related to the resource curse and DD in particular.

This study is based on different quantitative methods, namely graphical and econometric ones, as well as dynamic modelling. This is to bring together macroeconomic and microeconomic evidence to unravel some of the underlying mechanisms through which oil revenue management affects labour market outcomes. In doing so, it is suggested that resource revenue management and the resulting policies are key factors contributing to the conversion of a “natural resource curse” into a “natural resource blessing” – in particular, in terms of the impact of the Dutch Disease prediction on labour market outcomes, such as employment levels and wages.

This analysis contributes to the existing literature in three different ways. It shows: 1) the existence of a long- and short-run relationship between employment level, capital formation and exchange rate; 2) the influence of oil revenue on wage levels and wage inequality observed in Nigeria and 3) the impact of an oil shock on an economy with a large informal sector.

Indeed, the existence of a long-term relationship between employment, capital formation and exchange rate, with employment levels being negatively affected by Real Effective Exchange Rate (REER) appreciation as well as being complementary to capital has been confirmed. This implies that an increase in capital will positively affect the level of employment. To further

analyse this relationship, a firm-level panel survey was used to assess firm behaviour in relation to sector-specific exchange rates in the short term. The analysis of the survey also indicates that the exchange rate appreciation, which is linked to possible inflows of foreign currency, will, in the short run, negatively impact the labour market while playing a positive role in determining the level of capital through a substitution of relatively cheaper capital for relatively more expensive labour.

In line with this evidence, the influence of oil revenue on wage levels observed in Nigeria is explored. Given that the oil is concentrated in a specific region of the country (i.e. the Niger Delta region), my analysis explores the impact of fiscal federalism and oil redistribution on wage levels and investigates if oil contributes to inequality in wage levels across the country. The revenue sharing formula of the country implies that the resource-rich region receives significant oil revenue. With limited mobility in the country, it was found that firms located in the oil-rich region pay a wage premium compared to firms in other parts of the country. It was also found that this relationship holds for assumed similar levels of productivity and across sectors with a higher wage premium found in the services compared to the manufacturing sector. This analysis also assesses other possible mechanisms, such as the ability to obtain government contracts and the local price of inputs (i.e. local inflation in the oil-rich region).

Finally, to complete the picture, a DSGE model is built by considering the specificities of Nigeria, such as its credit constraints, wage and price stickiness, as well as its large informal sector, to assess different fiscal policy options. The analysis indicates that although the formal and informal sector benefit from the DD's spending effect through higher wages, the resulting low private investment in capital may take the economy on a lower growth path. In addition, saving options are, in the short term, mitigating the impact of the boom, even in the presence of the informal sector. Bringing these different aspects together, it is clear that Nigeria's oil revenue has impacted economic and labour market outcomes. This impact has cut across different aspects of the labour market, influencing both the employment level and labour prices in the country (i.e. wages). This has raised several policy-related issues, such as the role of revenue sharing rules on the country's overall competitiveness. Further, despite the large informal sector, the saving option still has superior outcomes compared to the spend as-you-go policy option.

This study concludes by arguing that to be able to better approach the adjustment process induced by the DD and mitigate its impact on the labour market, strong institutions are required to promote efficient and fair policies that will enable Nigeria to move away from rent-seeking behaviour. This will help resource-rich developing countries to mitigate shocks by developing appropriate policies responses. The lack of such policies could have lasting effects, preventing the private sector's capacity to sustainably generate work and decent wages.

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Chapter 1
Introduction

Large revenue inflows from natural resources are, in theory, expected to generate wealth, promote economic growth and enhance human development, as illustrated by the experience of countries such as Australia, Sweden and the United States (Wright and Czelusta, 2004; Lederman et al., 2007). These countries achieved early economic growth based on their relatively abundant natural resource sectors. This is in line with early economic literature, which states that economic development is limited by the amount of investment (Rostow, 1960). Thus, natural resource revenues could play the role of triggers and provide the capital required to fast track economic development (Sachs and Warner, 1999) and allow socio-economic growth to accelerate. However, since the second half of the 20th century, several empirical studies have suggested that many resource-rich countries have experienced perverse effects of natural resource wealth, as this wealth appears to have negatively affected their economic (McKinley, 2008), social or political wellbeing (as summarised by Ross, 2014): a phenomenon known as *"the resource curse"*. The first use of this term was attributed to Auty (1993), who argues in the opening paragraph of his book that "not only do many resource-rich countries fail to benefit from a favourable endowment, they may actually perform worse than less well-endowed countries".

Auty (2001a, 2001b) found that some resource-rich countries, such as Nigeria, Sierra-Leone and Angola, developed at a slower pace when compared with countries such as South Korea and Taiwan, where resource rent represents less than 1% of GDP (World Bank database, 2019). Auty (2007a, 2007b) observed the mechanisms of the resource curse, while Sachs and Warner (1995a, 1995b) formalised this theory by finding a negative relationship between economic growth rates and different measures of natural resource abundance, such as mineral production or share of primary exports, over the 1970-1989 period.

This trend has not faded, and the number of countries depending heavily on resources for over 50% of their exports has not decreased. Indeed, Dode (2012) estimated that around 75% of sub-Saharan Africa countries and over 66% of those in Latin America, the Caribbean, North Africa and the Middle East are still resource-dependent. Despite the significant revenue received at the turn of the century, many resource-dependent countries are underperforming in terms of their socio-economic indicators (Carneiro, 2007); they also present poor economic growth prospects (Sachs and Warner, 2001). Despite the damning empirical evidence, Ross (1999) explains that the resource curse's underlying causes or transmission mechanisms are yet to be clearly established. Nevertheless, the literature has advanced several mechanisms through which the vast exploitation of natural resources affects the economic growth of developing countries, including rent-seeking (Tornell et al. 1999, Auty 2001, Mehlum et al. 2006, and Robinson et al. 2006), poor governance (see Baland et al. 2000, and Torvik 2002), political or ethnic conflict, corruption, autocracy, (see Ross 2001, Arezki and Brückner 2011, Arezki and Gylfason 2013, Collier et al. 2009, Tsui 2011) and excessive borrowing (see Manzano et al. 2007 and Costantini, et al. 2006).

Among these channels, one of the key mechanisms through which natural resource wealth is paradoxically expected to negatively affect an economy is through Dutch Disease (DD). According to Corden and Neary (1982), Corden (1984), and Stevens (2003), DD refers to the 1960s effect that natural gas discoveries in the North Sea had on the Netherland's manufacturing sector. Following this discovery, the Netherlands' income substantially increased, accompanied by large inflows of foreign currency, resulting in: (i) the real appreciation of the exchange rate, (ii) the decrease of non-oil exports, (iii) upward pressure on the prices of non-tradable goods, and iv) the displacement of key production factors, mainly capital and labour, towards the gas sector (i.e. the booming sector) and the services sector (i.e. the non-tradable sector). The trade boom resulted in a deterioration in the production of other tradable goods and exports, as well as in an increase in the prices of non-tradable goods. Empirical evidence related to the existence of DD has been relatively mixed.

This, therefore, provides the rationale for the approach adopted in this thesis, which consists of independently assessing some of the complex relationships underlying the DD framework. Further, these predictions of DD have strong implications for resource-rich countries' labour markets, where empirical evidence directly assessing the underlying mechanisms remains scarce. Indeed, despite resource revenue inflows, many resource-rich countries face difficulties in diversifying their economies away from the resource sector, and to create much-needed employment. For example, in Nigeria, the oil sector is estimated to employ about 300,000 persons (ILO 2005), which is small for a population of over 170 million people. The definition of employment has not really evolved since the International Labour Organisation (ILO), in 1982, defined it as "all persons above a specified age who during a specified brief period, either one week or one day, were in the following categories: paid employment; or self-employment".

This definition of employment is now seen as limiting in the developing country context. This is illustrated, for example, by the concept of jobs presented by the World Bank in The Job Challenge Report (2013, page 49), "The concept of a job is actually much broader than wage employment. Jobs are activities that generate actual or imputed income, monetary or in-kind, formal or informal". This report describes jobs – including informal ones – as transformational for three reasons. Firstly, *living standards* improve with job creation, thus decreasing poverty rates. Secondly, *productivity* grows as efficiency increases through learning-by-doing, and thirdly, since jobs create a sense of opportunity, *social cohesion* is also improved. This further highlights the importance of jobs for developing countries, even more so in the context of resource abundance, as it brings in the social dimension of a possible resource curse. While acknowledging the complexity of these concepts throughout this thesis, I will mainly focus on the level of employment (at the national and sectoral level) and wages as the key labour market outcomes. This is mainly guided by data limitation as most datasets collect information based on the ILO definition of employment, thus this definition remains an important indicator of interest to policymakers.

In attempting to analyse the impact of resource revenue on labour market outcomes, Nigeria presents itself as a good case study. This is because the country has not escaped *"the curse"*. Nigeria is home to Africa's largest economy and has been recognised as such since the GDP rebasing exercise completed in 2014. Despite significant economic reforms placing the country as the leading light of the "Africa rising phenomenon" (as described by Taylor, 2014), and a return to political pluralism in 1999, Nigeria is still presented as a typical example of a country affected by the "resource curse", from both a political economy and economic point of view (Mähler, 2010). Despite $1.8 trillion (in constant 2010 US$) in net income received from the sale of oil over the last 50 years, Nigeria is struggling to significantly reduce poverty, with rates only declining marginally from 64.2% to 62.6% between 2003/04 and 2009/10. In addition, Nigeria has a broad-based population pyramid, with children making up 44% of the population. This means that 4.5 million Nigerians enter the labour market each year, but only a very small number are able to find formal jobs (Ufuophu-Biri 2014). These trends support arguments presenting unemployment and underemployment as an important factor behind the emergence of terrorist groups, especially in the poorer areas in the north of Nigeria (David et al. 2015).

This discussion highlights the fact that resource wealth does not automatically trickle down to poorer households and may have little positive effect on employment creation. The question of employment has long been at the centre of attention in development theory and is a key concern of policymakers. In the context of Nigeria, as stated by Teal (2012, page 3), "governments should undertake efforts to increase formalisation and ensure that education and skill mismatches are addressed". He argues that "barriers to micro and small enterprises" should be removed to enable "them to grow" and support entrepreneurship, "while small enterprise needs to be encouraged" (Teal, 2012 page 3). However, these recommendations appear to be disconnected from the broader macroeconomic context dominated by the country's resource wealth. To address this issue, this thesis will investigate some of the economic mechanisms through which natural resource wealth affects labour market outcomes, such as employment, through the analysis of Nigeria as a case study, as presented in the next section.

1.1 Principal Research Question

The underlying research question of this thesis is: What is the predicted impact of Dutch Disease symptoms on key labour market outcomes in resource-rich countries illustrated by the Nigerian economy? Throughout this project, evidence of macro-micro linkages between the abundance of resources and the labour market in a developing country context will be presented using some of the predicted impacts of the Dutch Disease (DD) framework.

The relationship between resource revenue and labour market outcomes has been treated indirectly through the impact of revenue inflows on a country's economic performance. This relationship is central to the existing resource curse literature (as presented in van der Ploeg, 2011; Stevens, 2003; and Frankel, 2010 literature reviews). In order to more directly assess the relationship of interest, the DD framework presents itself as a prime candidate, through its predictions assuming possible labour movement from tradable to non-tradable sectors, or an upward pressure on wages in the case of limited labour mobility. However, the substantial empirical literature has focussed on the DD's structural impact on the economy and the associated policy implications, such as in Corden (1984), van Wijnbergen (1984), Chatterji et al.

(1988), Brunstad et al. (1997), Gylfason et al. (1999), and Torvik (2002). This focus can be explained by complex dynamics affecting the labour market, even more so as developing countries' markets differ with, for example, thin manufacturing sectors, large civil services, large degrees of informality and heavy reliance on imported inputs. In addition, as highlighted by Murshed (2008, 2011), the impact of the adjustment resulting from the inflows of resource revenue can be mitigated by appropriate institutions and adequate policies, as illustrated by successful resource management settings in countries as varied as Norway and Malaysia. Thus, the roots of the resource curse may not reside in natural resource revenue inflows but may occur due to the ability to effectively manage these revenues.

Thus, to navigate this complex nexus of interlinked relationships, the focus will be on three of the key predictions of the DD model and, in turn, assess their impact on the labour market outcomes of interest. In order to best unravel some of the dynamics, I have used Nigeria as a case study within a quantitative research design. Indeed, the different datasets and analysis, as well as interpretations, are based on a quantitative approach.

1.2 Employment and Exchange Rates

1.2.1 Research Question and Contribution

My analysis of the first key relationship underlying the DD framework will present evidence of the relationship between real exchange rate movements (driven by oil revenue inflows) and the level of employment in Nigeria by investigating the long-run and short-run changes in the relative prices of capital and labour. In this section, I will answer two salient questions: *What was the role of the real exchange rate in explaining employment performance in Nigeria?; and, How did manufacturing firms adjust to industry-specific real exchange rates?*

This study is relevant as the literature has mainly focussed on the impact of the exchange rate on macroeconomic indicators such as growth and sectoral output (Anjola et al., 2018; Ismaila, 2016; Akinlo, 2015). Empirical evidence directly assessing the relationship between the exchange rate and labour market outcomes in developing countries thus remains scarce (Kim, 2005; Ngandu, 2008; Hua, 2007). Most of the available studies have focused on high-income countries, with very little attention devoted to the characteristics of developing economies. Kim (2005) argues that since the economic structure in developing countries differs from those found in developed countries, real exchange rate fluctuations will also have a different impact. Indeed, developing countries experience higher economic growth (Mobarak, 2005) and consumption volatility (Kose, et al. 2003), as well as an abundance of natural resources (Collier, van der Ploeg, Spence and Venables, 2010). They also face different capital flow patterns (Gabriele et al., 2000). These factors have significantly costlier welfare effects in developing countries compared to developed countries (Pallage & Robe, 2003).

Departing from Frenkel and Ros's (2006) cross-country analysis of Latin America – one of the most noticeable empirical studies approaching part of the question at hand –this analysis will fill a noticeable gap in the knowledge by assessing country-specific long-term relationships between the exchange rate and the Nigerian employment level. To the best of my knowledge, the only other study testing the direct link between exchange rate and employment level in Nigeria is Folawewo et al.'s (2012) study, which focussed on the sectoral impact of increased aggregate demand affecting import and export levels. This analysis differs from my own as it assesses, at the macroeconomic level, the labour intensity transmission mechanism through which labour and capital act as substitutes reflecting exchange rate movements. The second contribution of this study resides in its focus on providing an assessment of the short-run dynamics of this relationship, using the Nigerian trade-weighted industry-specific exchange rate and firm-level panel data. This study will be the first to provide a comprehensive assessment of the exchange rate impact on the level of employment in Nigeria.

1.2.2 Methodology and Data

The question of interest is approached from two empirical angles: first, time-series methods will be used to analyse the macroeconomic relationship between aggregate employment and other macroeconomic variables, including the real exchange rate and level of capital over time, and second, micro-level data will be used to assess the short-run dynamics between the trade-weighted industry-specific exchange rate and firm-level employment data.

To study the macroeconomic relationships and the possibility of a long-term equilibrium relationship, a cointegration analysis will be used and Johansen's (1991) vector error correction model (VECM) employed. This will help address specific times series issues, such as stationarity, that were ignored, for example, in Frenkel and Ros's (2006) study. This method, as discussed by Granger (1986), suggests the existence of a linear combination of non-stationary variables that exhibit stationarity properties and thus allow for non-spurious analysis and inference. This study of the relationship between employment and the exchange rate will be based on a yearly time series from 1980 to 2010 of variables such as the real effective exchange rate, employment, oil prices, and capital formation in order to capture macroeconomic variables that influence the private sector's investment, and possibly the labour/capital ratio, in Nigeria. Although the period covered was mainly dictated to by data limitations, it nevertheless covers key phases of the Nigerian business cycle, such as the pre- and post-structural adjustment period, as well as the recent commodity supercycle. Most of these time series have been obtained from the World Bank database; while the employment variable has been gleaned from the Groningen Growth and Development Centre (GGDC) database. The GGDC data presents employment data for ten sectors and, compared to other sources such as the ILO database, it takes into account consistency factors such as intertemporal consistency, international consistency, and internal consistency, meaning that these series do not present some of the structural breaks observed in other datasets. Thus, it is best suited for my purpose.

At the micro-level, to understand some of the dynamics of adjustment, firm-level data have been used to look at the relationship between employment and a number of variables, such as sector-specific real exchange rates and capital formation. To assess the short-run relationship, the GMM estimate has been used. This is the most appropriate panel econometrics method to maximise the benefits of using a panel dataset (See Hsiao, 1986, 2007 for a discussion on benefits of panel data). This method is applied to a panel enterprise survey which was conducted in Nigeria between 1998 and 2003. It was collected in two successive waves by the Centre for the Study of African Economies (Oxford) and financed by the United Nations Industrial Development Organisation (UNIDO). The survey was completed across nine sub-sectors, including the south-west region, eastern region and northern region of Nigeria. This survey formed the basis of several other analyses (See Malik et al., 2008 and Aigbokhan, 2011) as it is one of the few surveys presenting firm-level data. It will form the basis of this thesis' analysis as it is the only survey which was completed within the period of interest. In addition to this, and to aid the rigour of the analysis, an industry-specific trade-weighted exchange rate, using trade data from the World Bank database, has been built.

1.3 Wage Determination:

1.3.1 Research Question and Contribution

The second key relationship that this thesis investigates is the localised impact of resource abundance revenue on wages and wage inequality. According to the DD framework, wages are expected to be pushed upwards through aggregate demand feedback on the labour market. In assessing this prediction, I will answer the following questions: *What role does higher oil revenue distributed to specific sub-national entities play in determining wages? How do these determinants (including oil revenue) explain wage differentials across firms in the country?*

Studies on the roots of unemployment and underemployment in Nigeria have focused mainly on factors such as demographic trends (migration and population growth) as well as the skill mismatch (Aigbokhan, 1988, 1992; Oni, 2006). These studies fail to acknowledge the role that wages, and their determinants can play in influencing the employment level. This results from the general assumption that Nigerian real wages are not very high (Adebayo, 1999) and thus, discarding the role of wages in employers' decisions. Within this context, the link between oil revenue and wages at the firm level will be assessed, paying special attention to oil being characterised as a "point resource", meaning that the production is localised in a specific region of the country – the South-South (i.e. the Niger Delta region). An interesting characteristic of this region is the fact that it receives significant revenue from oil production through a revenue-sharing arrangement determined as a part of the country's fiscal federalism policy (Ekpo, 1994; Aigbokhan, 1999). Such arrangements are often used to balance two potentially competing interests, as described by Qiao et al. (2008, 1), between the notions of efficiency and equity within the federation, and the political cohesion of the federation and assertion of entitlement to revenues by the resource-rich regions. This very often results in oil-rich regions receiving a significant share of the resource revenue. Such differentials in fiscal capacity, coupled with limited labour mobility, may distort wages, affect competitiveness and motivate the adoption of inefficient "beggar-thy-neighbour" policies by a subnational government.

To answer this question – the role of oil revenue in affecting wage level and inequalities – I will assess the key determinants of wages by relying on efficiency wage theory, which explains how profit-maximising firms can set wages above market-clearing levels to compensate for factors other than human capital differences, in line with Aigbokan (2011). This class of model, which is estimated through a firm-level wage equation that takes into account oil production at the subnational level, can provide some explanation for upward wages rigidity, and possibly explain the positive relationship between wages and unemployment. Finally, to complete this analysis, I will assess the contribution of each of the determinants in explaining wage differentials/inequalities across firms, as well as quantifying the pure contribution of variables determining wages (using an equality decomposition procedure in line with Devkota et al. 2015).

1.3.2 Methodology and Data

The first step of this analysis consists of running a wage equation to identify causal effects, following Şeker (2012), where the wage at the firm level is assumed to be determined by the size of the firm, its exposure to international trade, and other factors including, in particular, firm-level characteristics. The firm-specific factors provide controls that indicate whether a firm's age, trade union activity, share of permanent workers or if it is located in an oil-producing region, will influence its decision to pay higher wages. This wage equation will be estimated using OLS (see Wagstaff et al., 1991).

Then, using the Step-by-Step methodology, as described in Hosseinpoor et al. (2006), the concept of the concentration index (CI) will be used to compute a wage Lorenz curve, and hence a wage Gini index, to measure inequality in wages across firms. Further, applying an inequality decomposition procedure similar to Devkota et al. (2015) allows computation of the weight of the different determining factors, including the firm's location in an oil-producing region, in explaining wage inequality in the country.

To conduct this analysis, pooled cross-section data from the World Bank Enterprise Survey (ES) 2014, as well as surveys from the same source completed in 2007 and 2010, will be employed. These surveys, based on stratified random sampling, collected a number of quantitative datasets of information through firm-level interviews regarding the business environment the participants faced and the productivity level of their firms. Thus, these surveys also provide information on firm variables, such as sales, wage bills, costs of raw materials, net book values of assets, as well as personnel data in the form of the number of permanent and temporary workers, and production and non-production workers.

1.4 Informal Sector and Fiscal policies

1.4.1 Research question and contribution

The last key relationship of interest is the role of fiscal policies driven by resource revenue inflows on labour market outcomes. This entails taking into account some features such as the informality characterising a resource-rich developing country's labour market. Thus, the underlying sub-question is: *How can basic fiscal policy measures affect a small oil-exporting economy during an oil shock, taking into account the existence of a large informal sector?*

An increase in natural resource exports and higher natural resource prices results in an inflow of foreign currency, which leads to higher fiscal spending in resource-based economies (Sturm et al., 2009). As suggested by the DD framework, the use of the influx of revenue from resources could impact the structure of the economy as a whole, but can also make countries vulnerable to the price volatility of exported commodities as well as the exhaustibility of natural resources. Under these circumstances, fiscal policies are relevant for the reallocation of natural resource revenues. To the best of my knowledge, this analysis will be the first to present a model that uses segmented labour markets specific to resource-rich developing countries to assess the impact of fiscal policies during a shock.

1.4.2 Methodology and data

This analysis relies on macroeconomic modelling that incorporates key characteristics of the Nigerian labour market, including formal/informal market segmentation, as well as wage and price stickiness, to best capture the impact of oil shocks on employment outcomes. To date, only a few articles employ the DSGE model for oil-producing developing economies. The dynamic stochastic general equilibrium (DSGE) model presented here will extend the work of Medina and Soto (2007), which presents the macroeconomic dynamics of Chile, a resource-rich country. I will enrich this model with several characteristics of a developing country, such as labour market segmentation. The most noticeable features of this model are: (i) the assumption that variables such as prices and wages are sticky, meaning they are partially indexed to past inflation, and (ii) there is a persistent habit in consumption. In addition, domestic production is divided between the formal and informal sector, similar to Ahmed's suggestion (2012). The model also features fiscal policy rules specific to resource-rich countries.

In general, DSGE models are built on microeconomic foundations. These models are dynamic as they assign a central role to agents' expectations and their intertemporal choices in determining macroeconomic outcomes. DSGE models internalise the interaction between policy decisions and agents' behaviour, thus serving the purpose of this analysis. Finally, within such a model, one can trace the transmission of the oil shock to the broader economy.

The DSGE model will be calibrated using Dynare and Matlab. The parameters will be calibrated using values from the associated literature or computed, using specific data for Nigeria obtained from sources such as the National Bureau of Statistics and, when necessary, from the literature on emerging and low-income economies. Central Bank databases will also be used as they include other key macroeconomic variables, such as money supply, exports, exchange rates, imports of capital goods and gross domestic product (GDP).

1.5 Summary of the Thesis Structure

This project aims to investigate the impact of DD predictions on labour market outcomes in a resource-rich country, using the case of Nigeria. The dissertation will be comprised of six further chapters using various economics methods to empirically test the possible impact of oil revenue on the labour market through the lens of the Dutch Disease framework. A brief overview of the six following chapters is presented below.

C**hapter 2** will review the existing theoretical and empirical literature on the Dutch Disease framework's mechanisms and predictions in general, with an emphasis on the labour market. It will also critically assess some of the assumptions underlying the framework and review related empirical work to show that evidence has been relatively mixed. This provides the rationale for the approach adopted in the thesis, which consists of independently assessing some of the complex relationships underlying the Dutch Disease framework. I will then review existing literature around the three identified relationships/sub-problems identified in this introduction, namely the role of the real exchange rate on the labour market; the effect and the determinants of wages and, finally, the impact of fiscal policies on the segmented (formal vs. informal) labour market.

Chapter 3 will assess the macroeconomic variables and the characteristics of the labour market through the lens of the three key relationships.

Chapter 4 examines the impact of the exchange rate on firms' employment decisions. This chapter will provide an assessment of both macro and micro-economic adjustment of firms to real exchange rate movements.

Chapter 5 looks at wage determination processes. The wage is a key mechanism through which oil abundance can impact the economy, according to the Dutch Disease framework. This chapter analyses the key determinants of wages and uses inequality decomposition methods to assess the role of oil revenue in the wage determination process, and explains possible wage stickiness.

Finally, **Chapter 6** analyses the impact of fiscal policy – a tool at the disposal of the government to stabilise the economy and the labour market. To answer this question, the chapter presents a small open economy DSGE model with labour market segmentation that will be enriched with several fiscal and monetary features specific to resource-rich countries, taking its cue from Medina and Soto (2007). This will be followed by a concluding chapter (**Chapter 7)**, summarising the key findings and policy implications of this study.

Chapter 2
Overarching Framework – The Dutch Disease

The disappointing growth performance of resource-rich economies has been a source of concern for policymakers (Auty, 2001; Sachs and Warner, 1999, Nili and Rastad, 2007, among others). Through the recent commodity super cycle (2000-2014), many resource-rich countries have received significant revenues as a result of new resource discoveries and increased commodity prices (Canuto, 2014, Erten et al., 2013). However, these economies are still struggling to maintain sustained economic growth and enhance socio-economic development (Carneiro, 2007; Oomes and Kalcheva, 2007; Stevens et al., 2015; Alberola et al., 2017).

As a result, a large body of literature, both theoretical and empirical, has focused on the impact of natural resource-related activities on a number of macroeconomic variables. This literature provides different explanations for how the *"resource curse"* works and manifests itself. Ranis et al. (2000) identify six mechanisms that, through the abundance of natural resources, could affect the achievement of sustained economic development. First, because of their over-reliance on resource rents, resource-abundant countries tend to overlook the importance of human development. Second, these countries adopt an import-substitution industrialisation model, with the effect of limiting economic development. Third, limited export diversification is affected by price volatility, which in turn affects growth. Fourth, the resource rents are often captured by an elite class or monopoly group, resulting in greater inequality. Fifth, resource rents increase rent-seeking activities at the expense of productivity activities. Finally, DD effects may seriously affect a country's non-resource tradable sector's competitiveness (Auty, 2001).

Auty (2001) and Ranis (2000) do not provide an explanation for the underperformance of resource-rich countries but merely reflect on other factors, such as policy choices related to the type of political systems and the choice of the developmental strategy that a country may pursue. These factors are the links determining the impact of natural resource endowment on a country's economic performance. Van der Ploeg (2011), echoed by Frankel (2010), presents a literature review with six possible mechanisms, including: (i) a Dutch disease framework, (ii) the negative impact through lower learning-by-doing, (iii) the role of institutions, (iv) rent-seeking behaviour leading to corruption, (v) volatility, and (vi) inadequate public policies. For our purpose, it is helpful to explain the natural resource curse literature by dividing it into two main categories:

The first category relates to the political resource curse driven by the fact that resource revenue inflows and their redistribution create incentives for relevant actors to adopt distorting behaviour, such as autocratic regimes, rent-seeking, corruption, and violence in the form of conflicts, as observed in Nigeria's history (Hausmann et al., 2003; Rodrik, 2004; Tornell et al., 1999; Jerome, et. al. 2005).

Indeed, Collier et al. (2004) and Fearon et al. (2003) argue that there is a negative relationship between resource production and the associated risks of conflicts, while Fearon (2005) argues that large resource-related revenue inflows are positively related to the probability of conflicts. Several papers argue that natural resource inflows are associated with violence through their impact on government — either by weakening the state's ability to fend off rebel groups, or by increasing the value of possible reward from rebel-related activities (de Soysa, 2002, Fearon et al., 2003,). Another strand of the literature suggests that resource revenues can result in conflicts not through their impact on a government's ability but through the impact on the behaviour of rebel groups. Rebels often originate in smaller and marginalised regions which have claims to independence based on a wish to avoid sharing locally-generated resource revenues with the rest of the country. Similarly, rebels could be tempted to fund their activities by looting commodities or by extorting funds from firms operating in the resource-rich regions (Collier et al., 2009; Dal Bo and Dal Bo, 2011; Ross, 2012). Some authors, such as Besley et al. (2009 a, 2010) have focussed on the relationship between governments and rebels by establishing a link between resource revenue and conflicts, pending the government's ability to negotiate peace between the different groups. Fearon (2004) argues that the duration of conflicts is linked to the credibility of the government to effectively redistribute resource wealth to local communities. Although Cotet et al. (2013) indicate that oil revenue inflows are linked to conflict and Lei et al. (2014) show that oil discovery increases the likelihood of conflict only by about 5–8 percentage points compared to a baseline probability of about 10 percentage points; the evidence of the resource and conflicts has been mixed as Brunnschweiler & Bulte (2009) find no correlation. Similarly, while studies incorporating subnational data report a strong link between oil and the likelihood of conflict (Collier & Hoeffler, 2004), others show no correlation (Bhattacharyya et al., 2019).

Further on the political aspect of the resource curse, it is thought that resource wealth stabilises autocratic regimes, reducing the probability of a democratic transition. Authors such as Omgba

(2009), Cuaresma et al. (2010), Andersen et al. (2013) and Wright et al. (2015) indicate that resource revenues are likely to allow authoritarian rulers to stay longer in office, as well as help incumbents to retain their position against possible autocratic challengers. The literature also points to the fact that the presence of resource revenues in autocratic regimes is associated with less media freedom (Egorov et al. 2009) and also encourages a more authoritarian legislative power (Gandhi et al. 2007).

The rentier effect is another at play: an increase in resource revenue can allow the incumbents to reduce taxes and encourage rent-seeking behaviour, and thus increase the cost of possible dissent or political change (Ross 2001a). Indeed, tax revenue is coupled with greater expectations and accountability from citizens, while increasing rent revenue allows authoritarian regimes to lower the need for taxes and reduce accountability expectations (Ross, 2004; Brautigam et al., 2008). In terms of evidence, Morrison (2009) highlights how resource revenues are linked to political stability in either democracies or autocratic regimes through different mechanisms. Those revenues are associated with higher social spending in the case of autocracies, and lower tax rates for elites in democratic systems. A few studies have scrutinised the rentier effect at the subnational level. McGuirk (2013) finds strong correlations between increased resource revenues and decreased tax mobilisation efforts, and a demand for democratic governance. The rentier effect assumes that resource wealth has no impact on rulers' incentives but actually impacts their ability to finances these preferences. Robinson et al. (2006), Morrison (2007), and Caselli & Cunningham (2009) argue that resource revenues impact the value attributed to political leaders remaining in office, instead of their ability to do so. These authors argue that rent revenues increase the benefits and value of incumbency, creating the incentive for the ruler to invest in staying in power.

The debate on the role of rent on the longevity of an autocratic regime and the impact of the type of regimes on conflicts is still ongoing. Herb (2005) and Aleex and Conrad (2009, 2011) argue that, overall, the autocratic effect of such revenues are larger than the potential gains, resulting in an anti-democratic impact. Many argue that this effect is conditional on a number of factors, such as government capacity (Mehlum et al. 2006), the quality of institutions (Andersen & Aslaksen 2008), trade-related policies (Arezki & van der Ploeg 2011) and the incentives of the political leaders (Caselli & Cunningham 2009).

The second category explaining the resource curse is linked to the economic factors resulting from the resource revenue inflows and the associated volatility forcing the growth path towards a different equilibrium. This effect is known as the Dutch Disease. The term “Dutch Disease” was first used in *The Economist* in 1977 (Corden, 1984) to describe the real exchange rate appreciation experienced by the Netherlands in the 1960s following the gas discovery in the North Sea. The phenomenon arises when revenue inflows result in a real exchange rate appreciation (Corden, 1984; Stevens, 2003), followed by an increase in spending (especially by the government) - (Wierts and Schotten, 2008; Van der Ploeg, 2011) - impacting the price of services not internationally traded. As a result, labour and capital shift from other tradable sectors to the more attractive booming resource and the services sectors, thus inducing a current account deficit, fuelled by imports consumption and lower exports, and resulting in large debt (Manzano and Rigobon, 2001). These trends are expected to impact growth negatively as the phenomenon is thought to be negatively associated with investment in human capital. (Gylfason, 2001; Matsuyama, 1992).

As argued by Frankel (2010), the DD impact can be problematic due to the volatile nature of the commodity prices and the difficulties in predicting them. As a result, policies supposed to mitigate those variations such as monetary policy and fiscal policy often contribute to the boom and bust cycles. The volatility in the price of the resource results in debt overhang and credit constraints, and impacts negatively on the government’s capacity for or degree of financial development (Mansano and Rigobon, 2001). Davis and Tilton (2005) and Humphreys et al. (2007) argue that the volatility impacts the international lending patterns, with resource-rich countries being able to borrow internationally when prices are high, thus accentuating the boom; however, in periods of falling prices, countries find it hard to access financing. This has been underlined by Van der Ploeg (2011) as the source of the debt crisis experienced by several resource-rich countries in the 1980s.

This volatility is exacerbated by underdeveloped financial systems (Rose and Spiegel, 2009). Beck et al. (2003) highlight the fact that in countries with high disease prevalence, the colonizers failed to permanently settle, thus appropriate extractive institutions were not developed (see Acemoglu et al., 2001). As a result, these countries inherited weak property rights and contract enforcement, affecting negatively financial sector development. Rajan and Zingales (2006) assessed that groups with vested interest, such as incumbent financiers, will use their existing market power to hamper financial sector development in order to retain their dominant position. Further, Bhattacharyya and Hodler (2010) argue that incumbent governments develop the incentive to hinder the development of the financial sector by facilitating corruption and weakening the political institutions. Thus, citizens choose to lend less capital to firms. However, when institutions are robust, being independent of resource revenue inflows, the incumbent government encourages development of the financial sector through strong contract enforcement.

Furthermore, volatility negatively affects growth, investment, equality patterns and educational outcomes (Aizenman and Marion, 1999). Indeed, resource revenues negatively impact investment in human capital through limited investment in research and development (Lee, 2011; Papyrakis, 2011) and lower school enrolment as non-wage income is pushed upwards (Gylfason et al., 1999; Gylfason, 2001). Auty (1998) points to the fact that the manufacturing sector generates positive externalities through the diffusion of technology and the related learning-by-doing effect. A reduction in the potential impact of those effects is likely to push the economy onto a lower growth path and specialisation in a low value-added extraction process. These are associated with increasing inequalities and the lowering of social human development levels, as illustrated by Carmignani (2013).

The impact of volatility is also exacerbated by inappropriate economic management, reflecting an aspect of the political curse. These resource revenues are a means of avoiding unpopular non-resource taxes and reducing demand for political reforms. This is illustrated by Ross (2007), who indicates that resource revenue windfalls reduce accountability, allowing the government to postpone addressing social issues such as the supply of services, such as infrastructure, health and education. More broadly, Chauvet and Collier (2008) highlight the fact that rent-related revenues negatively impact the speed at which government can put a halt to inefficient policies as resource revenue provides a cushion to maintain bad policies for a longer period.

Large resource revenue inflows and volatility impact spending patterns, such as investment projects and the government wage bill (Frankel, 2010). This is explained by Van der Ploeg and Venables (2011), who assessed the idea that developing economies should invest part of their resource revenue in public capital accumulation. However, Bhattacharyya et al. (2014) claimed that resource-rich countries appear to be experimenting in disinvestment in public capital, as the capital stock is inversely related to resource revenue; they argue that this policy error is another dimension of the resource curse. Despite such policies, resource revenue could be associated with increasing income and economic growth as a resource-driven boom is likely to attract foreign investment, and that may result in a misleading diagnostic of ongoing public policy and thus result in maintaining such a policy or failing to address it. The lower capital stock observed can be explained by public investment not reflecting development priorities, as well as often an over-ambitious disconnect from best practices of project management, such as value for money. Consequently, policymakers find it hard to continue financing such projects in periods of bust. In addition, several developing resource-rich countries face a limited capacity to appraise, implement and monitor projects; thus, a resource-driven boom results in the implementation of unproductive investments (Hertog, 2007). This limited capacity implies increasing rent-seeking and corruption practices, increasing more than proportionately with the resource revenue inflows, as illustrated by Ades and Di Tella (1999), Leite and Weidman (1999), Arezki and Bruckner (2011), and Sala-i-Martin and Subramanian (2013).

The trend in capital spending illustrates the fact that resource-rich governments adopt and maintain sub-optimal policies (e.g., Ross, 1999). This is exacerbated by the existence of political patronage, which accentuates the spending inefficiencies and pressures in periods of boom to the benefit of a specific group. This distortion aims to allow the government at that time to spend heavily in favour of a specific group and reduce the optimal amount of capital (i.e. contract too much debt), which is then passed on to the next government (Alesina and Tabellini 1990; Alesina and Drazen 1991). Rent revenues can be used by the incumbent government to credibly signal its ability and willingness to continue spending in exchange for being re-elected (Besley & Persson 2010). Increasing the wage bill goes in line with the argument that sees it as a means of the government hiring its supporters, thus impacting negatively on the quality of the public institutions (Robinson et al., 2006, 2014; Brollo et al. 2013). Medas and Zakharova (2009) highlight the fact that oil revenues are often used to increase public wage bills or to increase the number of civil servants, a type of spending hard to reverse in periods of economic downturn.

In line with the argument of economic mismanagement, the difficulties of many resource-rich countries to diversify their economy can be added. Many resource-rich economies have developed a specialised economic structure subjecting themselves to volatility and the inability to diversify their export base. Further, as underlined by Venables (2016), several resource-rich governments have attempted to implement several diversification strategies based on diverting resource revenue towards sectors unconnected to the resource sector, either through development banks or direct government industrial policy. He assesses that these have resulted in more failures than successes; thus, he recommends that to get around these curses, saving policies and improving the efficiency of financial markets should be the focus. However, Bahar and Santos (2018) argue that the moment of resource discovery matters in terms of economic diversification as countries where resources were exploited before reaching a certain level of industrialization will present a very different economic structure and diversification trajectories than countries that discovered their resources after this critical level had been reached. Indeed, resource exporting countries present a high degree of non-resource export concentration, characterised by the increased production of existing products, as opposed to adding new export lines. Beyond the DD framework mentioned above and discussed in more detail below, the authors established that not all the non-resource tradables are expected to shrink, but instead found that capital-intensive goods have a higher share of non-resource exports. This reflects the fact that resource revenue inflows drive wages upward against capital, which is freely mobile and, therefore, priced by international markets. Such a pattern is likely to negatively impact income equality and distribution within a country.

Most of the channels discussed above overlap each other, but the role of institutions does cut across these mechanisms. Indeed, empirical evidence supports the role that good institutional quality can play in turning the curse into a blessing (Mehlum et al., 2006 and Mavrotas et al., 2011). Bulte et al. 2005 highlighted that beyond economic growth, social and human development are also conditional on the quality of the institutional arrangement. This might be the missing link explaining the outliers such as the Norwegian case (Larsen, 2006). For example, Robinson et al. (2006) and Wiens (2014) highlight that in cases where institutions encourage corruption, resource revenue negatively impacts aggregate income, and the opposite is true in the case of efficient and transparent institutions. Part of the literature argues that institutions are endogenous to resource endowments, as resource wealth and the efficiency of institutions are inversely correlated (Bulte et al. 2005; Knack 2009; Anthonsen et al. 2012). This is also observed at the subnational level, as argued by Vicente (2010), who notes that oil discovery is associated with an increase in the perception of corruption in a number of public services administrations. Similarly, Brollo et al. (2013) found in the Brazilian context that an increase in resource transfer to municipalities is associated with a significant increase in corruption cases. In addition, the impact of resource wealth on institutions may also be conditional on the political system in place. This is illustrated by Andersen et al. (2012) and Bhattacharyya et al. (2010), who have offered evidence that resource revenues are more likely to be associated with corruption in countries described as autocratic compared to those using a democratic system. Finally, the level of institutions is correlated to the Government's involvement in the resource sector, in areas such as ownership, and this is associated with weakened state institutions (Luong & Weinthal, 2010). Another strand of the literature argues that the resource curse is linked to the resource revenue redistribution mechanisms used for institutional arrangements. This is illustrated by Torvik (2009), who highlights that good institutions mitigate the possible impact of resource revenue inflows on growth. In addition, Sarmidi et al. (2014) suggest that improvements in institutional quality would result in mitigating the negative effects of resource abundance on growth.

Institutions matter because they guide and determine policy choices that will help play a role in determining a government's ability to adopt policies that will help mitigate the impact of external shocks on the economy and maintain growth prospects (Rodrik, 2003). Indeed, resource management is the key to making the most of the resource inflows and adopting the relevant policies, as recommended by van Der Ploeg and Venables (2011). They argue an increase in resource revenue leaves the government with choices regarding public debt management, public investment and financial redistribution to citizens to enhance consumption, particularly if the boom is thought to be temporary. These results challenge aspects of the standard advice, consisting of building a sovereign wealth fund and limiting consumption to the interest accumulated on this fund (e.g., Barnett and Ossowski, 2003). Developing countries have an urgent need both for consumption to reduce poverty, and high-return domestic investment opportunities.

Finally, El Anshasy and Katsaiti (2013) highlight that institutions are key in improving economic growth prospects and fast-track human development. In particular, as argued by László Szalai (2018), institutions are key in mitigating the impact at the subnational level that suffers from a national economy affected by poor policies and the degradation of the local social tissue and environmental capital. Bhattacharrya et al. (2017) argue that resource-rich countries with democratic political institutions are more likely to opt for more fiscally decentralised policies, while countries with centralised political institutions are more likely to reduce/control the degree of autonomy granted to subnational units. On the one hand, resource discovery could encourage a revenue maximising government to centralise fiscal matters. On the other hand, resource discovery could give central government the incentive to share its power in order to either expand political patronage or to try and improve public spending efficiency.

Turning natural wealth into a blessing is a complex issue. Common prescriptions relate to the fundamentals of social-economic development, such as effective propriety rights and basic access to health and education services. More specific recommendations are required concerning the operation of the resource sector and the need for transparency and accountability mechanisms, in particular around the use of the resource revenue. However, as illustrated by the mixed results of the Extractive Industries Transparency Initiative (EITI) (see Williams, 2011; Acosta, 2013), transparency seems to be a necessary but insufficient condition concerning turning resources into blessings (Kolstad and Wiig, 2009). Such recommendations result in the consideration of more radical solutions, such as redistributing revenues to the public (Segal, 2012; Sala-i-Martin and Subramanian,2013) or domestic private ownership of the reserves (Weinthal and Luong, 2006). However, as highlighted by Stevens and Dietsche (2008), these recommendations are yet to be disconnected from the mechanisms by which institutions are formed and changed. After this broad discussion on the resource curse, the focus will now be narrowed down to consideration of the Dutch disease.

2.1 The Booming tradable sector and the Dutch Disease framework

Dutch Disease, the underlying framework of this project, was best formalised by Corden and Neary (1982). These scholars theorised a small open economy with three normal goods: one tradable and booming (i.e. a resource sector, such as oil); one tradable and non-booming (i.e. manufacturing or agriculture sectors) and one non-tradable good (the service sector). The price of the tradable goods is fixed by international markets, while non-traded goods prices are domestically determined. The real exchange rate is defined as the price of non-booming tradable goods relative to the price of non-traded goods. Another key assumption of this theory is that the different goods are produced using common factors of production. These include: a sector-specific non-mobile factor (capital) and a factor of production mobile across the different sectors (labour). The labour market can move between sectors to keep wages constant across the whole economy.

Within this setting, in the Corden and Neary (1982) model, a boom resulting from technical improvement in the sector, new discoveries or price increases affects the economy through the spending and resource movement effects. This mechanism is illustrated using Chart 1 and Chart 2 below, from Ali (2011). The horizontal axis represents services output (i.e. non-tradable goods) and the vertical axis includes oil and non-oil tradable output (i.e. tradable goods). The line SP represents the production possibility frontier, which represents the combination of all goods (tradable and non-tradable) possible, given the existing technology. The initial pre-boom equilibrium is represented by point A, where SP and the aggregate demand I_0 intersect. Thus, at this point, output is equal to demand. The slope of the line AP_0 corresponds to the initial real exchange rate and the line OY_0 is the combination of constant relative prices along which national income increases. The real exchange rate in this model is defined as the relative price of tradable goods to non-tradable goods.

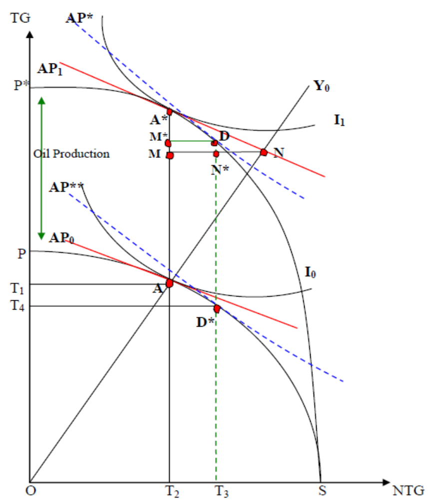
An oil boom does not change the non-tradable output, but it increases the tradable output, in particular with reference to oil. Therefore, the production frontier shifts upwards along the vertical axis from OP to OP*.

2.1.1 The Dutch Disease's Spending Effect

In order to isolate the spending effect, in Chart 1 below, taken from Ali (2011), it is assumed that the demand for labour is kept constant, thus eliminating the factor of production movement (i.e. resource movement). The expansion of the oil sector pushes the production frontier upwards to a new aggregate production point A*, while other outputs (i.e. non-oil tradable and non-tradable goods) are kept at A. In this new setting, A* is higher than A as the relative price of non-tradable goods is kept constant given that AP_1 is parallel to $AP_{0.}$ As a result of the oil boom shifting the production frontier, demand for other goods increases, resulting in a disequilibrium with demand (point N) exceeding the quantity of non-tradable goods that producers plan to supply (point A*). Thus, there is a gap (MA*), which is the balance of payments.

To restore the equilibrium and depress the excess demand, the real exchange rate must appreciate, and the market clearing point shift from A*to D. At this point, the push in the production frontier from the booming oil sector results in additional demand for non-tradable goods, but the move in the real exchange rate helps depress this demand; nevertheless, this still results in higher demand (MN*) and higher output (T_2 to T_3). The opposite is true for the other tradable goods, with the boom resulting in an increased higher demand which is further exacerbated by the real exchange rate appreciation (MM*), which is equivalent to a fall in domestic non-oil tradable goods (T_1T_4). Thus, the shortfall created in the sector is resorbed by imports, which increase from D to D*.

Chart 1: Dutch Disease's Spending Effect



Source: Adapted from Ali (2011)

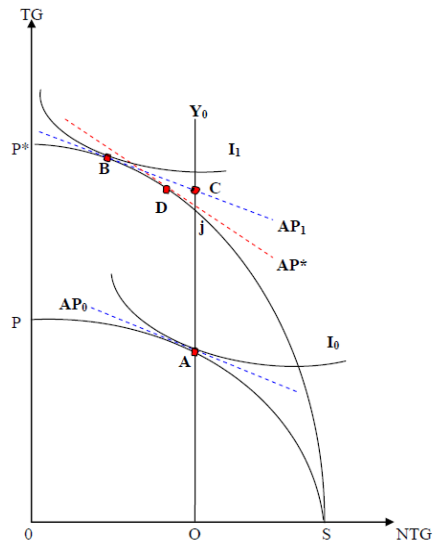
2.1.2 The Dutch Disease's Resource movement effect

The second effect of DD is the resource movement effect. In order to isolate this effect, which can be described as the movement of mobile factors of production, it is assumed that there is no change in demand for non-tradable goods in response to a change in income, as captured by Chart 2, from Ali (2011). Thus, OY_0 becomes a vertical line interacting with the new production frontier at the point J.

The booming sector leads to a wage increase in this sector as the marginal product – labour - is pushed upwards, thus attracting labour from other sectors. As the relative price for non-tradables is initially kept constant, the production of other goods (non-oil and non-tradable) declines, resulting in excess demand (point C). To restore the equilibrium, non-tradable goods' prices will increase, resulting in a real exchange rate appreciation. This results in the excess demand being resorbed and the initiated production decline is slowed down, moving the market clearing point to D.

In conclusion the resource movement results in a smaller amount of non-tradable goods, which also leads to a further real exchange rate appreciation affecting negatively the production of non-oil tradable goods.

Chart 2: Dutch Disease's Resource effect



Source: Adapted from Ali (2011)

2.1.3 The Dutch Disease and its economic impact

As a summary following the above discussion, Corden and Neary's (1982) model demonstrates that under the assumption of two factors of production, one being mobile and the other not, the combined impacts of the resource movement and spending effect are mainly twofold: 1) labour, the factor of production considered mobile, moves away from the resource none-tradable sector; and 2) the real exchange rate appreciates. Therefore, on the one hand, the non-resource sector is negatively affected through a loss of competitiveness and lower output. The decline linked to the resource movement is called "direct de-industrialisation"; while the one reflecting the spending effect is known as "indirect de-industrialisation".

On the other hand, the impact on the non-tradable sector is ambiguous as the spending effect leads to higher output, while the resource movement implies the opposite. Thus, the impact on output will depend on the inclination to consume non-tradable goods and the factor intensity of the different sectors. Indeed, the former will impact on the importance of the spending effect (Stijns, 2005), while the latter will determine the effect of the resource movement. In the case of a Nigerian oil sector relying heavily on non-mobile factors such as capital, the spending effect will prevail in the resource movement, resulting in a predicted increase in non-tradable output.

These impacts, including those on the level of employment and wages, are summarised in Table 1 below, adapted from Oomes and Kalcheva (2007).

Table 1: Summary of the Dutch Disease's Impact

	Output	**Employment**	**Wage**	**Price**
Resource movement effect				
Booming tradable sector (oil sector)	+	+	+	Given
Non-Booming tradable sector (manufacturing sector)	-	-	+	Given
Non-tradable sector (services sector)	-	-	+	+
Spending effect				
Booming tradable sector (oil sector)	-	-	+	Given
Non-Booming tradable sector (manufacturing sector)	-	-	+	Given
Non-tradable sector (services sector)	+	+	+	+
Combined effect				
Booming tradable sector (oil sector)	+	indeterminate	+	Given
Non-Booming tradable sector (manufacturing sector)	-	-	+	Given
Non-tradable sector (services sector)	Indeterminate	indeterminate	+	+

Source: Adapted from Oomes and Kalcheva (2007), Diagnosing Dutch Disease, Does Russia have the symptoms?

2.1.4 Alternative views on the Dutch Disease

From the above, the production of non-resource tradable goods is expected to decrease following a resource boom. The predictions of the Corden and Neary (1982) model could be different if based on another set of assumptions. In that case, the de-industrialisation, given as almost certain, may not materialise and the DD may not exist at all.

Indeed, since the appearance of the original model, the literature has developed a number of theoretical extensions based on a different set of assumptions and extended the basic model by including, among others, monetary policy issues, market rigidities, international factor mobility, and knowledge spillovers - van Wijnbergen (1984), Buiter et al. (1983), Krugman (1987) and Matsuyama (1992). Furthermore, this literature has attempted to internalise and capture some of the effects arising from increased capital stock in non-booming sectors, and exchange rates and fiscal policies, both in static and dynamic models (see Harvie and Maleka, 1992; Harvie, 1993; Cox and Harvie, 2010). These multiple studies validate, in part or completely, the predictions of the core model developed by Corden and Neary.

In line with the above, Hsieh et al. (1998) developed a model taking into account capital stock, like many other existing studies, but they internalised the households' labour supply trade-off between labour and leisure. This model found that the DD effect is exacerbated and, even in the event of non-traded goods being produced through a capital-intensive process, aggregate capital stock does not increase if households are more willing to substitute labour for leisure. Similarly, Hamilton and Hartwick (2008) developed a model for a small resource-rich economy open to trade resources, producing resources and other goods. This economy also has a non-tradable sector and it is also assumed that it imports capital. The conclusions show that DD effects still exist, and the amount of capital imported falls following a resource boom.

Bruno and Sachs (1982), based on the basic Corden and Neary model, captured the inherent dynamics of the DD effect on different sectors. The resource boom results in lower demand for non-resource tradable goods and higher demand for non-tradable goods., thus shifting profitability and capital accumulation trends from one sector to another. In their model, Bruno and Sachs, by assuming an open economy, show how capital can move between the different sectors, thus keeping the marginal product of capital constant. Even under this assumption of international capital mobility, the DD effect still exists. Similarly, Buiter and Purvis (1982) relaxed the DD model assumption by presenting a model with international capital mobility, rational exchange-rate expectations and sticky domestic goods prices within the context of a country that can control the price of its non-resource goods. Their model found that a resource boom has a temporary negative impact on non-resource sectors, as non-resource prices are predetermined and sticky; the exchange rate is likely to appreciate beyond its long-run equilibrium value.

While some of the studies mentioned above confirm or partly confirm the prediction of the core model, others invalidate the prediction. Indeed, Corden (1984) and Neary and Purvis (1981) show that against the prediction of the Dutch Disease, in the event of large unemployment and underutilised capital, a resource boom could boost the non-booming tradable sector output. In addition, Kojo (2015) highlights that if factors of production are perfectly mobile internationally, which could realistically be assumed in the long run, the resource-driven shock will not impact the real exchange rate, and thus the DD prediction will not materialise. Under the assumption of perfectly mobile capital and labour, the production of non-tradable goods will expand to accommodate the increased demand by attracting international capital and labour without negatively impacting the other sectors. With this possibly highly elastic supply of non-tradable goods, wages will not be pushed upwards, and the world interest rate will keep capital in the tradable sectors constant; as a result, real exchange rates could remain unchanged. Under this assumption, outputs across the different sectors expand (see van der Ploeg et al. 2011).

Corden (2010) reinforced this argument by analysing the case study of Australia, where the resource movement effect of the DD framework does not occur. According to Corden, the underlying reasons for this include: (i) a labour shortage in the extractive sector (booming sector) can be mitigated by a skilled migration program; (ii) the extractive sector often operates as an enclave and it is not labour intensive; and iii) high capital mobility reduces the sectoral shift of factors of production (such as labour). Indeed, Downes et al. (2014), using the case of Australia, argue against the possible trade-off between sectors as the booming sector can drive demand in other sectors.

An entire field of literature has been developed to address the DD framework, and to suit the context of less developed economies. For example, in the case of Cameroon, Benjamin et al. (1989) found that, in relation to an oil boom, in the presence of features such as the imperfect substitutability between domestic and imported goods, the predictions of the model are likely to be different. They found, using a general equilibrium model, little evidence of the DD occurring in Cameroon.

To conclude, in this section, it is apparent that the theoretical literature on the DD framework points to the existence of a de-industrialisation phenomenon, which can be defined as a shrinking manufacturing sector resulting from a resource boom. Nevertheless, the de-industrialisation is not always supplemented by the predicted real exchange rate appreciation, which can be attenuated by internationally mobile factors of production. Thus, the DD framework is sensitive to the underlying set of assumptions and might not exist in some contexts. This will be further discussed in the next section reviewing the empirical evidence.

2.2 Empirical Literature and Rationale for Focusing on Salient Key Relationships

The theoretical predictions of the DD framework have attracted a lot of empirical attention, as summarised by Stevens (2003). Although a number of theoretical studies, as presented above, validate the prediction of the DD framework, the empirical literature is much more divided and a source of debate, given the complexity of the underlying assumptions and the sensitivity of the DD framework to changes in these underlying assumptions. The empirical approach to the DD paradigm, according to Kojo (2015), can be classified into three groups: (i) a number of studies which have based their estimations on cross-country or panel data, such as Arezki et al. (2010), Rajan et al. (2011), and Lartey et al. (2012); (ii) others which rely on country-specific data time-series analysis, such as Richards (1994), Oomes and Kalcheva (2007) and Algieri (2011); and (iii) country-specific analyses using stylised facts, such as Dobrynskaya and Turkisch (2010).

Indeed, the evidence of the negative impact of an oil-related boom and real exchange rate movement on the manufacturing sector has not been obvious, with Gelb (1988), Sala-i-Martin et al. (2003) and Larsen (2004) finding no impact in their studies. Similarly, the existence of the DD and the lack of firm evidence across case studies have been discussed in Stevens (2003). However, more recent studies appear to find a negative relationship between resource wealth and the non-resource sector, such as Harding and Venables (2010), who found that increasing resource exports by $1 will result in a reduction of non-resource goods exports by $0.5. This increase will also lead to higher imports (increased by $0.15) and a reduction in non-resource exports by $0.65. Brahmbhatt, et al. (2010), in the conclusion of their study, found that in resource-rich countries, the tradable sector output is approximately 15 percentage points smaller than expected. Ismail (2010) estimates that an increase in oil revenue by 10% will negatively affect manufacturing sector value-added, resulting in a falloff of about 3%. In line with these studies, Elbadawi et al. (1997), through a study of 62 developing countries, found similar results, and Lartey (2008,) in the case of the Philippines, found that DD predictions hold.

In general, the mixed empirical evidence rests on a number of factors, including the lack of a common definition of Dutch Disease and an unclear definition of the different sectors affected (see Kojo, 2014, Harding et al., 2013). Also, as highlighted by Kojo (2014), the underlying mechanisms of DD can be complex. For example, the DD effect may not materialise as a significant proportion of the resource revenue inflows is used in the form of foreign outflows to buy imported goods and services or acquire foreign assets. Finally, country-level analyses can shed more light on the underlying mechanisms as they capture unique factors affecting the real exchange rate or the trade balance. They also reflect a given country's fiscal and monetary policies, as well as market characteristics or private sector dynamism, through the notion of absorptive capacity.

In relation to the above, Oomes and Kalcheva (2007) investigated the determinants of real exchange rates to assess whether the Russian economy had, from 1995 to 2005, experienced a resource-boom related real exchange rate appreciation. The paper also focussed on the possible contraction of the manufacturing sector through the analysis of output and employment growth rates at the sectoral level. In sum, although they established that the Russian economy suffered from DD, they underlined the complexity of attributing the observed trends to DD only, as they might be confounded with other factors which were not controlled for.

Similarly, still in the Russian context, Mironov and Petronevich (2015) analysed the link between the real exchange rate and possible structural economic changes in the Russian economy. They found that the real exchange rate impacted negatively on the manufacturing sector and wages between 2002 and 2013, while the return on capital was positively affected across different sectors. Thus, this analysis, based on the standard model, found evidence of DD. Further important country-specific empirical studies include Mogtosi (2002), Looney (1990), Forsyth and Nicholas (1983) and Egerbt et al. (2008).

The observed lack of consistent empirical evidence could also be as a result of some of the assumptions underlying the framework; thus, to fully assess the complex and multifaceted relationship of interest to this thesis, I will look more closely at the country-level studies of some of the key predictions of the framework, and assess their possible impact on the labour market.

2.3 Exchange Rates and the Dutch Disease

Firstly, the model developed by Corden and Neary assumes that factors of production are fully utilised. However, responses to a resource boom in a developing country may be different from the theoretical predictions reflecting imperfect markets, structural issues such as infrastructure gaps or other economic policies recurrently captured within the resource curse literature. Thus, the predicted impact on different sectors and unemployment as discussed in sector 2.1.3 is uncertain.

In addition, the production inputs or services in many developing countries are imported, and capturing this assumption distorts the theoretical predictions of traditional models, which rely on the assumed comparative advantage of final goods (Kojo, 2015). For example, in the case of real exchange rate appreciation, exports of final goods may be affected negatively, but when a country relies on imports for intermediate goods entering its production process, final goods may actually be cheaper. This ambiguous relationship in developing markets provides the rationale to closely analyse the linkages between exchange rates and some of the predictions of the standard model regarding labour market outcomes, such as employment levels.

2.3.1 The Role of Commodities in Determining Exchange Rates

As suggested by the DD framework, an oil-related boom will, in theory, impact the real exchange rate. This theory defines the equilibrium real exchange rate (RER) as the rate reflecting the equilibrium level of a number of internal and external factors. These factors can include taxes, international prices, capital flows and technology (Edwards, 1989, 1994). This suggests that the equilibrium real exchange rate is sensitive to any changes in any of the factors affecting the economy. Thus, in a resource-rich context, movements in resource prices will affect the RER through its effect on the terms of trade. As a result, the role of resource prices as a determinant of RER cannot be understated, as suggested by Aron et al. (1997); however, it is not the only possible factor.

There is a vast literature looking at the linkages between resource prices and the RER (as illustrated by, among others, Edwards (1985); Douglas et al. (1997); Amano et al. (1998); Chen et al. (2002); Spatafora et al. (2003); and Cashin et al. (2004)). These studies have established a positive relationship across a number of countries. Among these studies, Cashin et al. (2004), by assessing the determinants of RER, finds that in 15 out of 44 resource-rich countries, there is a long-run relationship between resource prices and national RER. Furthermore, those prices are key factors underlying the RER.

Similarly, Chen and Rogoff (2002) find that commodity prices have an impact on the RER of a number of resource-rich countries, such as Australia, Canada and New Zealand – economies that rely heavily on commodity exports. More specifically to oil-exporting countries, studies analysing RER and real oil prices have presented mixed results. This is illustrated by Korhonen and Juurikkala (2007), who established a link between increased oil prices and RER appreciation in a study of nine OPEC countries, including Nigeria. These results are consistent for country-specific analysis with, for example, Zalduendo (2006), Koranchelian (2005), Mongardini (1998), and Oomes et al. (2007) reporting similar results for Venezuela, Algeria, Egypt and Russia.

Nevertheless, some studies have presented statistically insignificant or weak relationships between commodities prices and RER: for example, in the case of Norway (Akram, 2004; Bjørnland et al., 2008). Similarly, Gauthier and Tessier (2002) find that this relationship is insignificant in their case study analysis of Canada, while, Habib et al.'s (2007) analysis of Russia, Norway and Saudi Arabia – countries among the world's largest oil exporters – establishes that there is no relationship between prices and RER in Norway and Saudi Arabia, yet this relationship turns out to be positive for Russia.

2.3.2 Other Channels for Exchange Rate Determination

As presented above, resource prices can be a key determinant of the exchange rate, but they are not the only factor. Among other factors are the level of output, inflation, the openness of an economy, interest rates, the domestic and foreign money supply, the exchange rate regime and central bank independence (Stancik, 2007). The degree of the impact of each of these factors varies and depends on a particular country's economic condition.

There have been a number of studies, mainly using data from developed countries, on the underlying factors affecting the RER (e.g. Williamson 1994; Isard, 1998; MacDonald, 1997; Betts and Kehoe, 2008). Only a few of these focus on developing countries: for example, Lee et al. (2007) use a panel cointegrating relationship for a sample of 48 countries to establish that increases in net foreign assets and in fiscal position are key determinants of real exchange rates.

Zalduendo (2006), studying determinants of equilibrium RER in Venezuela, finds that other than oil prices, declining productivity also plays a significant role in impacting the equilibrium RER.

Similarly, Bayoumi and Mhleisen (2006) present a long run and short run assessment of the Canadian RER determinants and find that in the short run RER movements are mostly linked to energy commodity prices. However, in the long run, through an error correction model, they have established that non-energy commodity prices have a greater influence on the RER. MacDonald (1997) shows that primary factors, such as private sector productivity levels and impacts of trade, fiscal and monetary policies, have a significant bearing on determining both long and short-run exchange rates. Similarly, Mahidhar (2006) argues macroeconomic fundamentals and global political uncertainties are factors that cannot be ignored when looking at exchange rate levels.

Most of these studies have used various empirical methods to assess different determinants of Dutch Disease. These methods and determinants are summarised by Bems and de Carvalho Filho (2009) as follows: (i) Behavioural Equilibrium Exchange Rate approaches, based on the assumption that RER is a function of macroeconomic fundamentals, such as government spending, trade policies, and productivity levels across sectors (i.e. the Balassa-Samuelson effect); and (ii) quantity-based approaches that relate to the relationship between current account positions and a number of variables including resource production and reserves, population and fertility growth-rates, a country's GDP, etc. In addition, as suggested by Rickne (2009), variables reflecting the political and legal institutions of a given country can be included in these analyses. The third determinant of DD concerns balance-sheet-based approaches, which present the RER movement as the level that restores equilibrium in the foreign asset market.

2.3.3 The determinants of the exchange rate in the Nigerian context

The empirical evidence of the impact of commodity prices on RER determination is also inconclusive in the Nigerian case. Olomola (2006) studied the impact of an oil price shock in Nigeria and showed that oil prices impact the exchange rate; however, oil prices do not affect output and inflation. Hassan and Zahid (2011) and Ozsoz and Akinkunmi (2011) also argue the existence of a positive long-run relationship between real oil prices and the RER. However, Coleman et al. (2012), analysing the oil-price exchange-rate relationship, did not find a relationship between Nigerian RER and real oil prices. This is in line with Sala-i-Martin et al.

(2003) who could not establish any evidence of an impact of oil prices on the Nigerian RER between 1968 and 2000 as the oil price and different measures of exchange rates were weakly correlated. They argued that one of the key determinants was linked to political economy factors. Thus, the evidence is mixed as exchange rates can be affected by a number of other factors.

Beyond the role of oil, several other factors can impact the exchange rate. There is a large body of literature that assesses the possible determinants of the exchange rate in Nigeria (further discussed in section 3.6). While these studies, using various econometrics methods and analyses, return different opinions on the drivers of the exchange rate, they reveal that key macroeconomic variables, such as the balance of payments driven by oil abundance, terms of trade dominated by oil price and external debt, and the external reserve, contribute to the determination of the exchange rate in Nigeria. The literature also indicates that the weight of these factors differs in degrees and in different periods of Nigerian history.

Further to the macroeconomic variables, policies and management can be underlying factors impacting the exchange rate. Indeed, as an oil-exporting country and import-dependent country, the exchange rate is a crucial tool for protecting the economy from speculative attacks and currency crisis, as well as achieving long-term growth. In the light of the number of changes in exchange rate regimes in Nigeria, Eruma et al. (2018) argue that the political pressures and interest groups have affected the management of the exchange rate there and identify politics, institutional incentives, and group interests as some of the key drivers of Nigeria's exchange rate regime determination process.

2.3.4 The chosen approach to the Exchange Rate

Based on the above, empirical studies have returned mixed evidence in assessing the various determinants of the exchange rate; however, it is evident that the determinants are not unique, and that they contribute to different degrees and are dependent on specific situations. Thus, in line with Ezirim (2006) and Demir (2010), it may be assumed that exchange-rate determinants can be a set of economic and non-economic factors, such as changes in the balance of payments, import/export interconnections, changes in foreign reserves, monetary and fiscal policies, GDP growth, the price volatility of commodities, and socio-political factors. This thesis will not attempt to disentangle the underlying determinants, but it will rather assume the exchange rate as given and as reflecting policy choices made, undoubtedly, in response to the abundance of resources that is clearly present within the Nigerian context. The aim of the analysis will be to study the short and long-run dynamic evolution, and interrelationship, between the exchange rate and employment, in line with the argument that policies resulting from revenue inflows impact the labour market through DD.

2.3.5 Empirical Review of the Impact of Exchange Rate movements on Employment

Evidence of the direct impact of exchange rates on the level of employment remains relatively scarce. Studies have mainly analysed the effect of RER on output at the aggregate and sectoral level, and the evidence presented by these studies has been mixed. Existing studies assume an inverse relationship between a currency movement and employment level. Several studies confirm the existence of this inverse relationship, such as Alexandre et al. (2009), Demir, (2010), Frenkel (2004), Nucci et al. (2004), Burgess et al. (1998), Revenga (1992) and Branson and Marston (1989). In contrast, some analyses have established no relationship between the exchange rate and employment (or a weak relationship, if present) but rather investigated more pronounced effects on other indicators such as wages (Campa and Goldberg, 1999). Some studies even find a positive relationship, such as those undertaken by Ngandu (2008) and Adewuyi (2005).

There are many studies focusing on the linkages between exchange rates and employment in developed economies such as the US. In the 1980s, one of the main challenges faced by the US economy was associated with a possible de-industrialisation process. This strand of the literature points to the fact that RER levels have an impact on American manufacturing employment levels. Further, this effect is also assessed as different across sectors, with tradable goods such as machinery and ‘hard goods’ responding negatively to a currency appreciation (see Branson and Love, (1988); Branson and Marston, (1989)). Similarly, in the European context, Sekkat, and Mansour (2000) claimed that the production of tradable goods is sensitive to exchange rate movements. The study concluded that this sensitivity was driven by the European market structure.

In the context of less developed economies, with specific market characteristics, such as a large informal sector, underemployment and scarce capital, evidence is mixed. On the one hand, Dao and Chen (2011), in the case of China, show that a real appreciation lowers employment growth in tradable sectors (mostly manufacturing), as well as non-tradable sectors (i.e. transport, wholesale/retail trade). Frenkel et al. (2004) establish that RER appreciation in a number of South American countries for the period 1980-2003 resulted in a negative change in the level of employment. Similarly, Eichengreen (2008) found in a study of 40 emerging countries that a real exchange rate depreciation has a positive impact on the level of employment in the manufacturing sector. On the other hand, Filiztekin (2004) concludes that in the case of Turkey, due to the reliance on imported inputs, a real exchange rate depreciation has a negative net impact on the level of employment. At a more sectoral level, Ngandu's (2008) study on the South African economy and its manufacturing sector found, using a partial equilibrium model, that a currency appreciation impacts negatively on the level of unemployment, while a general model indicates that an exchange rate appreciation could result in job creation through the reallocation of labour from sectors such as leather products and chemical products through to hiring sectors, such as mining and other services.

This discussion around the differentiated effect of RER on economic sectors reinforces the need to focus on a country's specific experience. Further, as such suggested by Goldberg (2001), assessing exchange rates would require analysing industry-specific exchange rate movements. In line with this last point, Koren (2001) used firm-specific RERs in Hungary to illustrate the sensitivity of some sectors to exchange rate movements, thus reflecting the fact that demand and cost factors are sector-specific. For example, this study found in the food sector that an RER depreciation caused employment to rise. However, on an aggregate level, Koren (2001) could not conclude on the direction of the impact between RER and labour demand. Thus, against those mixed results, historical evidence of the effect of RER on labour demand at both the macroeconomic and the microeconomic level, using industry-specific exchange rates, will be provided.

2.4 Wage Determination and Dutch Disease

As discussed above, the DD framework, in its static form, predicts that the overall wage level is expected to increase due to resource revenue inflows. However, in the context of unemployment and/or underemployment, the boom in the resource sector can result in existing excess labour supply being absorbed without it being drawn away from the non-booming tradable and non-tradable sectors. In a similar manner, the non-tradable sector can hire additional labour to respond to increased demand without pushing wages upwards. Within this setting, the DD predictions, such as a real exchange rate appreciation, will not materialise. As highlighted by van der Ploeg (2011: 409), *"It is worthwhile to investigate further the effects of resource dependence on wage formation"*. This provides further support for the rationale to assess the role of oil revenue in the wage determination process in Nigeria.

2.4.1 Resource Abundance and Wage Determination

The wage determination process is a complex process and mostly reflects labour market characteristics, such as wage stickiness. Indeed, like standard markets, wages and any observed wage differentials should reflect the forces of demand and supply, guided by profit-maximisation decisions, productivity and human capital characteristics.

Further, within a competitive labour market, it is assumed that the existence of unemployment is the result of prices, in this case wages, not reflecting market-clearing levels as a result of possible market rigidities. In addition, wage differentials should reflect compensation for differences in labour supply, which result in higher productivity. In the context of resource-rich countries, the resource curse literature suggests that the over-employment of citizens in the public sector, for example under generous conditions, is one of the main channels of mass rent circulation, contributing to these rigidities. This could also negatively impact productive activities if wages in the private sector are indexed to those relatively high public-sector wages (King 2009; Hertog 2016).

2.4.2 Impact of Resource Revenue on Wages

The evidence of the role of oil as a determinant of wage rates remains scarce. Many of the existing studies cover oil and gas exporting countries in transition, such as Kazakhstan, Russia and oil transiting country (indirect dependence) such as the Ukraine. Rahmanov (2007) finds that oil shocks have an impact on a number of variables, including wages. Indeed, in the Ukraine and Kazakhstan for example, oil price increases have led to an increase in real wage growth and inflation. Similarly, Oomes and Kalcheva (2007), in the case of Russia, show that wage increases observed across different sectors since the turn of the century, reflect the impact of DD. In another context, Vazquez-Alvarez (2010) finds in the United Arab Emirates (UAE) a significant wage premium, which is viewed as a transfer mechanism to redistribute resource wealth to citizens. This premium is supposed to boost the labour supply. In addition, by keeping wages above the market clearing level, the government can increase returns on schooling but also attract a foreign labour supply, which can foster a learning-by-doing process. Finally, across resource-rich African countries belonging to the common economic zone (CEMAC), Trevino (2011) finds a significant increase in the wage bill related to the spending effect of DD.

2.4.3 Alternative Wage Determination Theories

Beyond the impact of resource-related wealth, the literature has developed a number of efficiency wage frameworks to analyse the rationale behind the fact that some profit maximising firms are paying the labour supply above the market-clearing level for reasons other than to compensate for skills and higher productivity (World Bank, 1995:27). These frameworks provide an explanation for sticky wages, even when structural bottlenecks such as labour unions are accounted for. These theories approach wage efficiency from different angles, such as the nutritional aspect (i.e. a wage level allowing workers to ensure continued labour supply); the limiting of staff turnover; and shirking labour.

These approaches suggest that paying labour above the market clearing level reflects the willingness to increase the monetary trade-off between employment and unemployment, and therefore increase the probability of retaining labour, possibly leading to higher productivity (Bulow et al., 1986; Azam et al., 1997). Another variant is the “adverse selection theory” developed by Weiss (1980) that sees wages as a mechanism to entice the more capable candidate with the relevant skills to apply for a job and, thus, reduce the adverse selection problem. Groshen (1991) provides a summary of these theories by presenting a literature review on the rationale behind wage premiums. Many of these frameworks, including the nutrition-related theory, were established for labour markets in advanced economies, but remain relevant when discussing developing countries.

The last variant of these theories is the rent-sharing theory, first exposed by Akerlof (1982, 1984), which argues that wages are a tool to retain employees; in return for higher wages, employees are likely to be more productive. In this theory, loyalty is positively related to a share of profit redistributed to employees. In the resource-rich countries context, the DD’s spending effect on firms will act as a trigger for other firms to offer higher wages. This is to possibly compensate for the high cost of living and/or to retain labour in the light of limited labour mobility (at the subnational level, for example).

2.4.4 Wage Determination: Empirical Literature

Aighokan (2011) offers a summary of the existing empirical literature. Given the focus in this paper on the impact of oil on wage determination, the studies in developing country contexts, focusing on rent-sharing theory, will be highlighted.

Among these studies, a key study on a developing country is Teal's research (2000), based on a Ghanaian survey, which confirmed the existence of a rent-sharing mechanism at play in the labour market in that country. The empirical approach was based on a firm-level dataset covering the period 1991-1994 which was used to run regressions related to production and earning functions. Further, in a previous study based on wage function, Teal (1996) found that the existence of a rent-sharing mechanism through the role played by labour unions in the wage determination process was pushing wages upwards – the wage premium was estimated to be over 45%. Contrary to these studies, still in the Ghanaian context but with an updated dataset, Soderbom and Teal (2001) were unable to establish the existence of an efficiency wage mechanism.

Soderbom and Teal (2002), using a Nigerian dataset including both manufacturing sector firms and employees' characteristics for the year 2000-2001, ran an earnings function. In this study, initially focused on the wage determination process, they established that standard variables related to employees, such as experience, age, and schooling, played a role in determining wages. Similarly, at the firm level, variables such as the number of employees, turnover and capital stock impacted wages offered to employees. Interestingly, although the study did not set out to test the rent-sharing hypothesis, the analysis, surprisingly, indicates that profit per worker, a proxy for rent-sharing, is not a key determinant of wages. Nevertheless, Soderbom and Teal (ibid) recognised the possible existence of an efficiency-wage related mechanism manifesting itself through wage differentials paid by firms of different sizes:

> "[one] set of explanations argues that workers of the same quality do get paid more by large firms. One of these explanations argues that monitoring of workers is more expensive in large firms so that to ensure workers work hard the penalty from failure to do so needs to be higher in such firms […] This is part of the efficiency wage argument for firm size wage differentials […] There may be other explanations for such a correlation. It may be that workers in more productive firms can obtain higher wages, a form of rent-seeking" (Soderbom and Teal, 2002: 53).

This paper, however, completely ignored the possible role of resource abundance on wages, in particular the role it plays in oil-producing regions receiving significant revenues as part of the revenue sharing arrangement (This will be further discussed in chapter 5, by analysing the factor contributing to wage inequality in the Nigerian context). Further, Valenchik's (1997) research, based on a Zimbabwean dataset, including firms' and employees' characteristics, tests different variants of the rent-sharing theory. It found that rent-sharing is a key underlying factor in the wage determination process. Furthermore, it presented the fact that rent-sharing might be the driver of firm size, as pointed to by the theory: firms sharing profit are more likely to be more productive and, thus, larger. Azam and Ris (2001), in the Ivorian context, point at the fact that rent-theory and employees' bargaining powers are more likely to be the key drivers of wage determination, while evidence of efficiency-wage link is weak.

Overall, the existing studies point to the fact that rent-sharing is an underlying factor in wage determination. Thus, in the context of a developing oil-rich country like Nigeria, one can expect the abundance of resources to be a major determinant of wages, and to contribute to wage inequality.

2.4.5 Impact of Oil on Wages at the Subnational Level

In the case of a federation and the presence of a point resource – known to affect growth prospects more negatively than other types of natural resources (Engerman et al., 2002; Isham et al., 2004), the DD framework, if considered at the subnational level, will have an impact. Indeed, with significant revenue gleaned from revenue-sharing agreements, and in the absence of migration or limited labour mobility, these dynamics are likely to impact wages at the subnational level. This analysis will be the first to investigate such mechanisms in the case of Nigeria.

The natural-resource wealth literature has moved away from regressions based on cross-country data sets, as per Sachs and Warner (1995), to within-country investigations, as suggested by the survey undertaken by Marchand and Weber (2018). A body of literature has emerged focusing on the impact of resource revenue at the subnational level on several indicators, including wages. In the developed country context, Papyrakis and Gerlagh (2007), in the US context and using a subnational level dataset, established that an abundance of resources (measured by the proportion of resource to the subnational GDP) and household incomes are negatively related. Black et al.'s study (2005) established that at the local level in the US (using county-related data) the resource boom experienced in the ‘70s and ‘80s resulted in a surge in the number of local residents, as well as higher labour demand in non-mining sectors and increased workers’ compensation. The opposite is true in the case of a resource-driven downturn.

More recently, Jacobsen and Parker (2016), still in the US, also established that the local economy benefits from an increase in resource wealth as several variables, such as labour demand and employees’ compensations, are increased; however, these impacts are only temporary and are reversed in downturns. Jacobsen and Parker further indicated that some of those economic variables do not return to their pre-boom levels, resulting in a long-lasting economic downturn affecting, durably, the local economy and livelihoods. Similarly, Mamo et al. (2019) found and quantified the impact of production and discovery of minerals on economic development at the subnational level in Sub-Saharan Africa. Between 1992 and 2012, the analysis of 42 districts points to the fact that mining activities resulted in increased night lights by between 2 and 4 per cent – this is a measure of economic activity based on satellite imagery capturing the intensity of energy consumption at night; while a new discovery leads to significant increase in economic activity – over 55 per cent and this impact is noticeable two years prior to effective mining production. This positive impact lasted over time as economic activities increased by around 20 per cent by the sixth year, and about 45 per cent by the tenth year. However, this impact quickly fell away after the end of the mining operations, thus, highlighting the transitory impact of natural resource activities, which is consistent with the “resource curse” result in the macro-literature.

Overall, these studies suggest that the extractive industry generates at least temporary higher employment levels and an upward pressure on salaries. However, the empirical evidence related to the impact of resource revenue inflows on the manufacturing sector against one of the key predictions of the DD framework is mixed, which suggests a shrinking manufacturing sector. Another strand of the literature concentrates on the effect of a local resource boom on manufacturing-related activities; again, the empirical evidence is mixed, with a number of studies presenting a negative impact on the manufacturing sector; others indicate the opposite trend. On the one hand, increased manufacturing activities can be explained by economies of scale and network effects, as well as increased demand resulting from the boom. On the other hand, local inflationary pressures from labour costs and other services could be a drag on the manufacturing sector. In conclusion the evidence is still inconclusive.

In addition, the underlying mechanisms through which this impact is felt at the subnational level are intrinsically linked to the way the windfall is being used. The literature, such as that presented by Berman et al. (2017), shows that mining activity was linked to conflict within African countries for the capture of their resources. Contrary to this view¸ Bhattacharyya et al. (forthcoming) find no significant evidence of the impact of resources on the probability of conflict. This relationship is robust and independent of a number of control factors, such as resource type, size of discovery, and institutional quality. These results stand both at the regional and national levels. This is in line with the argument developed by Collier et al. (1998) and Fearon et al. (2003), which argues that resource wealth results in higher income and better quality of life as hinted at by evidence of the improvement of night lights following the resource discovery. Therefore, conflict comes at a greater cost to individuals and is, therefore, less likely. Another strand of the literature approaches the question from a different angle. Caselli and Michaels (2013), as well as Borge et al. (2015), assess the response of local politicians to resource revenue inflows related to oil in Brazil and hydropower in Norway, using variations across municipalities. The former finds that higher public-goods spending and resource windfalls are not proportional, while the latter argues that increased local government wealth results in less effective public goods delivery. In addition, Brunstad and Dyrstad (1997) analysed the resource boom in Norway and identified the demand and cost-of-living effects as the two distinct ways through which wages are impacted. These research efforts are important as they combine aspects of the Dutch Disease framework and the local demand shocks literature, and provide the broad framework for analysis in this thesis. Cust and Poelhekke (2015) summarise the literature discussions on the topic.

Given this overview of the literature, several questions remain unanswered. For example, the impact of the resource at the subnational level remains of interest, in particular related to the effect of oil revenue inflows on wages in both the manufacturing and other sectors at the local level. To answer these Dutch Disease-related questions, the use of firm-level data is still scarce. Recent papers, such as those by Allcott and Keniston (2014), De Cavalcanti et al. (2015), and Crust et al. (2015), provide some insight by looking at firms in the manufacturing sector. They find that wages increase in response to oil discovery and exploration at the subnational level; however, these papers pay little attention to the direct impact of resources on wage determination at the firm level. This is surprising since the crowding-out of manufacturing described as part of the Dutch Disease mechanism is driven by increasing wages among other factors. Further, an important area of inquiry pertains to the fact that within firms, wage inequality may not capture the dynamics at the national level. Indeed, firm-level approaches to inequality can result in deepening inequality across the sector and country. Thus, for the first time in the Nigerian context, evidence of the contribution of oil in overall wage inequality will be presented in this thesis. This will contribute to explaining how micro-level decisions impact wages throughout a sectoral labour market.

2.5 Informality, Fiscal Policy and Dutch Disease

Finally, government policies (i.e. fiscal policies), in response to the possible impact of resource revenue, will have an impact on the labour market. Real appreciation, declining economic sectors, and the possible loss of competitiveness associated with a resource-sector boom may not be sources of concern if they reflect the transition from one equilibrium to another and do not automatically require government intervention, unless the new equilibrium is a lower-growth one, as van Wijnbergen (1984) proposes. Corden (2012) defends this position and argues that in the event of DD, the optimal response should be to “do nothing” if the new equilibrium is not a lower growth one which allows the exchange rate to appreciate and to shift consumption and wages upwards through lower import prices. Thus, an intervention could reduce welfare and undermine domestic investment. A better understanding is needed given the complex impact of government policies and the fact that, in the developing country context, a number of rigidities, such as formal-informal market segmentation, wage and price rigidities and habit formation, are affecting the adjustment mechanisms (as described by Corden, 2012). To develop this understanding, the DSGE approach has been adopted as it provides a sense of the interaction between the formal and informal economy, as well as of the adjustment mechanism following a shock.

2.5.1 Fiscal Policy and the Dutch Disease framework

The possible existence of DD is a source of concern for policymakers. This is because they are confronted with a choice of adopting a laissez-faire approach, which will allow the booming sector to expand, possibly with negative impacts on other productive sectors and generally be associated with spending the revenue inflows (Lama et. al 2012), against an interventionist approach that will curtail growth in the booming sector and protect the other economic sectors, while saving part of the revenue inflows. Cespedes et al. (2014) established that most resource-rich countries adopt the former option, which translates into economic volatility and pro-cyclicality, while the second option is linked with imposing mechanisms to limit spending. Further to this, Shakeri (2009), when discussing the evidence of DD, observed that it is not generalised, as discussed in the empirical literature. He argues that, among other factors, government intervention plays a significant role in mitigating the impact, and that it could explain the lack of empirical evidence of the Dutch Disease phenomenon.

The use of fiscal policies within an economy possibly prone to DD has been the source of literature debates. In cases where the government needs to intervene to curtail the resource boom, fiscal policies are the most appropriate tools. Corden (2012) points to the fact that reducing the deficit, and even turning it into a surplus, is an appropriate policy response as it will depress demand and deflate prices, pushing interest rates downwards, which in turn will result in an exchange rate depreciation. Conversely, higher government spending and larger fiscal deficit would have the opposite effect as it aggravates the effects of Dutch Disease by accelerating exchange rate appreciation (Orrego & Vega 2013).

Furthermore, other government interventions, such as protecting the non-booming tradable sector, could worsen the DD impact on those sectors as such measures could result in lower import levels, resulting in an even higher exchange rate appreciation. In addition, Corden (2012) argues that "picking winners", i.e. sectors that benefit from government support, could worsen the impact on other non-protected non-resource tradable goods sectors. A contrasting view sees fiscal policy as playing no role in mitigating DD, as Bruno and Sachs (1982) indicate that government intervention in the long run can do very little to impact a resource boom.

In conclusion, the real exchange rate appreciation following a resource boom is just a mechanism through which an economy moves to another equilibrium. Although, in the short run, this transition can result in economic disruptions, the shift in medium to long run could benefit economic growth and improve welfare. Stapledon (2013), in the case of Australia, shows that, despite the disruption accompanying a resource boom, the economy expanded as a whole, including other tradable sectors. Additionally, Matsen and Torvik (2005) argue that decisions around windfall spending are the roots of the possible negative impacts that are associated with DD. Their analysis indicates that lower spending, usually geared towards consumption, could result in harnessing the positive impacts of DD. Furthermore, if an economy can ensure that "learning by doing" results from the resource boom, it will be no worse off, but actually be on a higher growth path. Thus, the role of government should be to assure that its interventions, like unrestrained spending, do not aggravate economic distortions (Sachs & Warner 1997).

2.5.2 DSGE modelling and developing Resource-Rich Countries' specificities

As discussed in the next chapter, fiscal policy has been at the heart of the management of oil resources in Nigeria. To assess the macroeconomic dynamics underlying an oil-producing country and the impact of fiscal policies, a DSGE model will be used to present how the fiscal policy (i.e. doing nothing or saving) could impact several economic variables. Although DSGE modelling for resource-rich countries has received more attention, it is still a relatively new area of research, in particular for developing countries, given their specificities.

2.5.2.1 Developing Countries and Informality

Labour markets in the developing world often present specific characteristics, such as segmentation, in particular in sub-Saharan Africa. Thus, to understand how a complex phenomenon such as DD could impact the economy will require an understanding of this segmentation to appreciate any responses to shocks.

In the sub-Saharan Africa (SSA) labour market, segmentation is along the lines of formality versus informality, as illustrated by Kingdon et al. (2006). This assessment identified several characteristics of SSA labour markets: (i) wage flexibility, as real wages move in the same direction and in reaction to unemployment levels; (ii) sectoral rigidity, with the existence of sectors paying relatively higher wages (i.e. the formal sector) against sectors characterised by lower wages (the informal sector); and (iii) the fact that this dichotomy is particularly interesting in the developing world as the informal sector (i.e. low paying sector) comprises the higher share of labour. (Charmes 2000; Blunch et al. 2001).

Further, Kingdon et al. (2006) explained that in SSA, this fragmentation can be found across the different labour markets, confirming the existence of a small formal high paying sector co-existing with a large informal low paying sector. The wage differential across these sectors is large and cannot be ignored when looking at the economic impacts of possible shocks. This is a characteristic of the Nigerian labour market that will be modelled in this thesis.

2.5.2.2 DSGE Modelling with Labour Frictions

Until recently, dynamic stochastic general equilibrium (DSGE) models were not designed to include key factors characterising a functioning labour market, such as unemployment or segmentation. This shortfall was recognised by academics such as Blanchard et al. (2010) and Gali et al. (2011). This oversight is described by Blanchard (2009 p 212) as "a striking (and unpleasant) characteristic of the standard New Keynesian DSGE model".

To address some of these criticisms, recent works in DSGE modelling have developed the capacity to integrate labour market imperfections into a modelling approach as presented by Blanchard et al. (2010), Gali (2010), Castillo et al. (2012), Christiano et al. (2010) and Mattesini et al. (2009). Thus, many of these models include features of search and matching theory that address some of the shortfalls of the modelling approach. In addition, the estimates in these models also show improvements in matching data (see Christiano et al., 2011, and Gertler et al., 2008).

Nevertheless, most of these developments fail to internalise the labour market heterogeneity. Fields (2009) argues that modelling the labour market as a single market belies a lack of realism, given, as discussed above, the fact that employment and labour supply are intrinsically heterogeneous. This heterogeneity has long been acknowledged by the literature and has resulted in developing analysis presenting, at least, a dual labour market. This is slowly transpiring into the DGSE modelling approach, as illustrated by Mattesini and Rossi (2009). This paper has analysed duality in the labour market reflecting a sub-market characterised by flexible wages, while the other sub-market is affected by sticky wages reflecting structural bottlenecks, such as labour union activities. The above authors concluded that output is determined by the interaction and relative importance of the different sub-markets.

In line with Mattesini and Rossi (2009), Castillo and Montoro (2012) assumed that the dual labour market is driven by the existence of formality versus informality. Furthermore, they included labour market rigidities in their model in order to assess the linkages between the two sub-markets and the impact of government policies, such as monetary policy. They assumed that the firm hiring labour would consider the fact that the formal sector is characterised by higher productivity while, at the same time, facing a comparatively higher degree of tightness – i.e. it is easier to hire labour in the informal sector than in the formal sector. They concluded their study by highlighting that an increase in aggregate demand would increase the size of the informal sector, and by stating that the opposite is also true in the case of an economic downturn.

Other studies, such as Batini et al. (2011), introduce informality as per Zenou (2008) to analyse the impact of shocks in the context of limited access to credit. Zenou's (2008) work is an extension of the Harris-Todaro model, taking into account a search-matching approach to characterised labour fragmenting in the developing country context. The model assumes that wages in the formal sector are the result of a bargaining process, while the informal sector's wages are the result of competitive processes, reflecting market forces.

Finally, studies like Conesa et al. (2002) purport that informality is introduced in a real business cycle model by assuming a less efficient production process, resulting in the existence of a wage premium in the formal sector. Ahmed (2012) relaxes the assumption made by Conesa et al. (2002) regarding the indivisibility of the formal labour supply. He assumes that households have a choice between either of the sectors, while an informal worker is assumed to prefer leisure over a higher wage.

However, these analyses are designed within a closed economy context. Senbeta's (2013) study, based on a New Keynesian DSGE framework, was one of the first to address labour market fragmentation (formal vs. informal) within an assumed open economy. Although Senbeta's paper relaxes the closed economy assumption, it does not include a financial sector and ignores the capital accumulation assumption. However, these features could have significant implications for performance, given the characteristics of the developing country's economic structure and the economic phenomenon of interest. Indeed, these limitations matter as the large informal sector in developing countries is characterised by a limited access to credit, thus limiting growth and investment. These constraints are not as stringent for formal sector firms, resulting in a higher capital to labour ratio.

Thus, within the existing literature, the DSGE model developed in this thesis is in line with the model presented by Conesa et al. (2002) as it introduces an informal sector using a differentiated production process compared to the formal sector. It also includes an informal labour market.

Thus, the model has an informal production process and an informal labour market co-existing with formal labour and production markets. The two sub-labour markets are differentiated on the basis of productivity, with the formal sector assumed to be more productive than the informal sector; as a result, the formal sector commands a wage premium. Unlike Ahmed (2012), the mobility between both sectors is limited and households are assigned a sector and cannot move to another sector. As a result of these assumptions, flexibility arises from households deciding on the working hours they are willing to supply to maximise their utility function.

2.5.2.3 DSGE Modelling and Oil-Rich Countries' Specificities

The DSGE literature capturing the characteristics of resource-rich countries is developing relatively quickly. This body of work mostly captures standard assumptions of DSGE modelling and adjusts them by introducing characteristics specific to resource-rich contexts. Morales and Saez's (2007) publication was one of the first papers to capture the dynamics of the Venezuelan economy through a DSGE model assessing the impact of resource-driven shocks on spending and investment. This model is an extension of the model developed by Gali and Monacelli's (2005) which included sticky price-determining mechanisms. In their model, Morales and Saez departed from the standard Taylor's rule characterising the monetary policy function to a rule that accommodates increased government spending. Thus, they highlight the role of international reserves to manage the exchange rate and interest rate.

Batte et al. (2008) used a DSGE model to assess the DD mechanism following positive oil shocks within the context of Nigeria and the West African Economic and Monetary Union. They assume that oil-related inflows are partly spent through households and partly saved in a stabilisation fund. In conclusion, they found that without the appropriate fiscal policy, only a flexible exchange rate policy prevents the DD from materialising. Batte et al. (ibid) also found that a policy mix involving fiscal expansion and foreign inflow from resource revenues would increase aggregate demand and affect negatively the private sector through the crowding-out effect. This loss of competition is mitigated if government spending targets the stock of capital.

Along the same lines, an IMF article (Dagher et al., 2011) investigated oil price shocks on Ghana's economy. This model included resource revenue inflows in both the fiscal and monetary policies by including the government and central bank constraints. In conclusion, the increased spending initially had a limited effect on prices; however, gradual increases in spending on non-tradable goods added inflationary pressure.

Further examples include studies such as Benkhodja (2014) and Allegret and Benkhodja (2015) that analysed the welfare loss associated with a resource-driven shock. These papers investigated the appropriate monetary policy rules that could mitigate the impact of an eventual DD effect and concluded that a flexible exchange rate policy could lead to positive economic outcomes, both in the case of boom and of bust. Similarly, Pieschacon (2012) studied the appropriate fiscal policies and their impacts in the Mexican and Norwegian context. He concluded that isolating the economy from oil revenue inflows with the appropriate fiscal policies leads to better outcomes.

Finally, Medina and Soto (2005), in the case of Chile, developed a model to study resource price shocks, extending the work of Gali and Monacelli (2005) and their model, which explicitly included oil as an input for firms and as a consumption good for households. Medina and Soto (2005) allowed for substitution between oil and other consumer goods, as well as among inputs in the production process. These authors computed counterfactual policy responses to an oil shock under several different monetary frameworks. They established that revenue-related inflows result in lower aggregate output as the interest rate is pushed upwards. In addition, alleviating wage stickiness eases the process of input reallocation, resulting in superior outcomes compared to policy options aimed at depressing price increases.

In the same spirit, this study will rely on certain macroeconomic modelling, incorporating key characteristics of the Nigerian labour market, such as segmentation, to capture the effects of government macroeconomic policies on employment outcomes. Thus, a dynamic stochastic general equilibrium (DSGE) model will be developed which follows Medina and Soto (2005) by including labour market duality in a small open economy. This will be enriched, however, with several fiscal features that are specific to resource-rich countries, such as an excess crude account, which will be further discussed in the following chapter.

Chapter 3:
The Nigerian Economy and Labour Market

3.1 Introduction

In this section, the choice of Nigeria as the case study for this project is presented. One of the central reasons for this choice is that Nigeria offers an opportunity for the different relationships underlying the DD framework that inform this study's focus to be analysed.

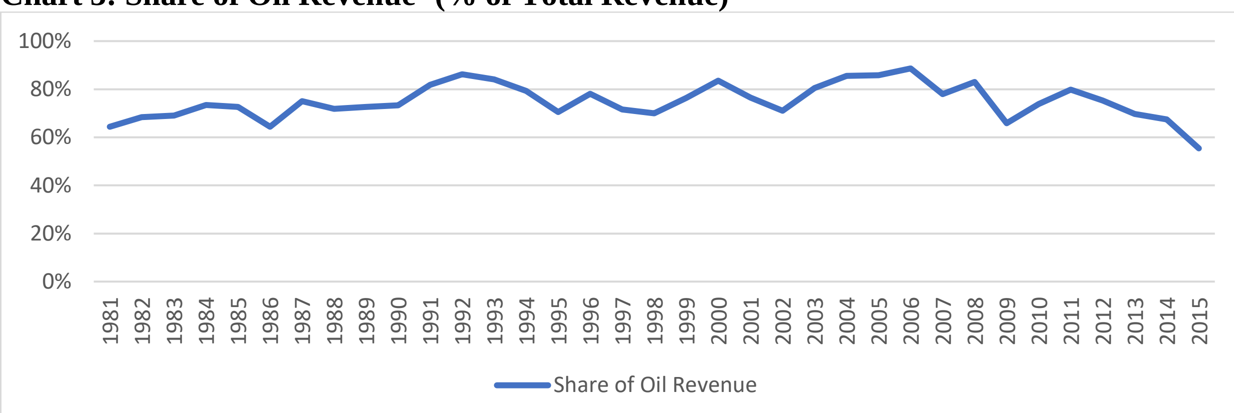
While several emerging economies, such as India and China, are making significant socio-economic progress, Nigeria, Africa's largest economy (since the statistical exercise leading to the revision of its GDP base in 2014) and the fourth-fastest growing economy in the world from 2000-2010 (Chawla, 2015; Folarin et al., 2016; Ajakaiye 2015) is experiencing increasing poverty and unemployment/underemployment. Despite the robust GDP growth of 8% observed between 2000 and 2010, poverty levels increased in absolute terms given the population growth rate and the marginal decrease in poverty rates between 2003-2004 and 2009-2010 (NBS data). At the same time, the labour supply increases each year by 4.5 million (Museri, 2009; Seth et al., 2018); however, only a very small proportion can enter the formal private sector, reflecting a lack of dynamism of this sector, and a severe structural issue affecting formal employment growth. Thus, unemployment has grown by over four percentage points between 2009 and 2011, affecting almost one person out of four. This trend has mainly affected the young (15-24 age group), where over one person out of three is estimated to be unemployed. (NBS data, Akeju 2014). These underlying trends reflect long-run demographic patterns and are thought to have been accentuated by the recent economic downturn in 2015 and 2016, which goes beyond the period under study.

Nigeria is rich in resources, having by 2015 received over $1.8 trillion in oil revenue (based on the 2010 constant price). Despite significant revenue from oil, serious developmental challenges remain, and the country is often presented as a typical example of a country affected by the "resource curse", from a political and an economic point of view (Collier et al., 2001; Le Billon 2005; Auty 1993). These challenges include substantial poverty, increasing inequalities, a large agricultural workforce, spatial inequality, and conflict-prone areas (Mähler 2010; Fenske et al., 2017; Ogbalubi 2013). The discussion below links the abundance of oil in Nigeria to a number of socio-economic developments, including those in the private sector. The section thereafter investigates some of the particular characteristics that pertain to Nigeria informed the choice to focus on this country as a case study.

3.2 Oil Abundance

Nigeria discovered oil in 1956 and production reached commercial levels in the early 1970s. Since then, Nigeria has earned over $1.8 trillion in oil revenues, between 1971 and 2015. This represents almost four times the 2015 GDP (in constant 2010 USD). The sizeable oil revenue inflows represent net wealth and thus create additional fiscal space for government spending, but they have resulted in creating a reliance on a highly volatile commodity, thus complicating macroeconomic policymaking (Sala-i-martin 2008). The share of natural resource mining/ drilling as a proportion of GDP rose substantially from the 1970s, to reach 50% of Nigeria's GDP in 2005. It also represented close to 90% of exports (Ogwumike et al., 2008) and around 80% of federally collected income (Adedipe, 2004; Adenikinju, 2006), as illustrated in Chart 3.

Chart 3: Share of Oil Revenue[1] (% of Total Revenue)



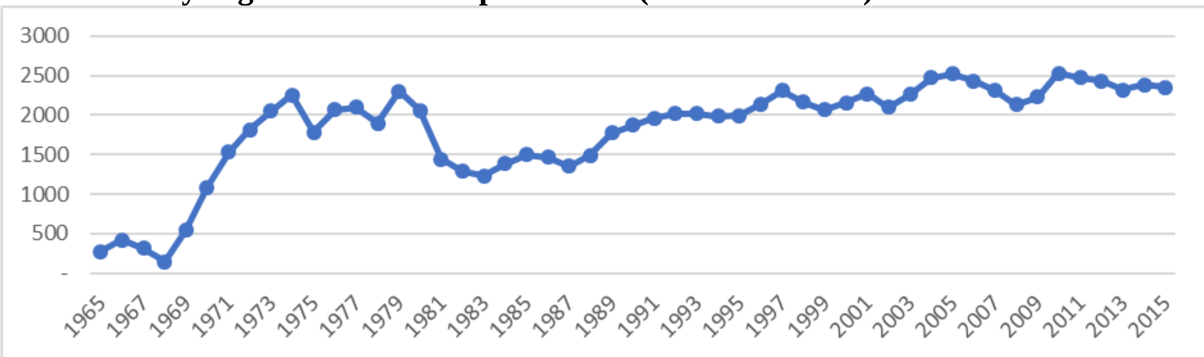
Source: CBN Statistical Bulletin 2016, total oil revenue as a share of total federally collected revenue.

In 2016, Nigeria produced an estimated 2.5 million barrels of oil per day (Chart 4). It then ranked eleventh and eighth among oil-producing and oil-exporting countries, respectively. This difference reflects the country's small domestic oil consumption (BP Statistics 2017). The OPEC annual report of 2017 indicates that Nigeria currently has an estimated oil reserve of 37.4 billion cubic metres, which makes it the second-largest reserve in Africa behind Libya with proven

[1] Oil revenues consist of (i) crude export earnings of the NNPC; (ii) profit taxes and royalties of oil-producing companies (usually joint-venture companies with a government majority ownership); and (iii) domestic crude sales and upstream gas sales.

crude oil of 48.01 billion cubic metres, and the tenth-largest reserve in the world. The country's gas reserve is put at 5 trillion cubic metres, compared to 6 trillion cubic metres for the United Arab Emirates (OPEC, 2018).

Chart 4: Daily Nigerian Crude Oil production ('000s of Barrels)

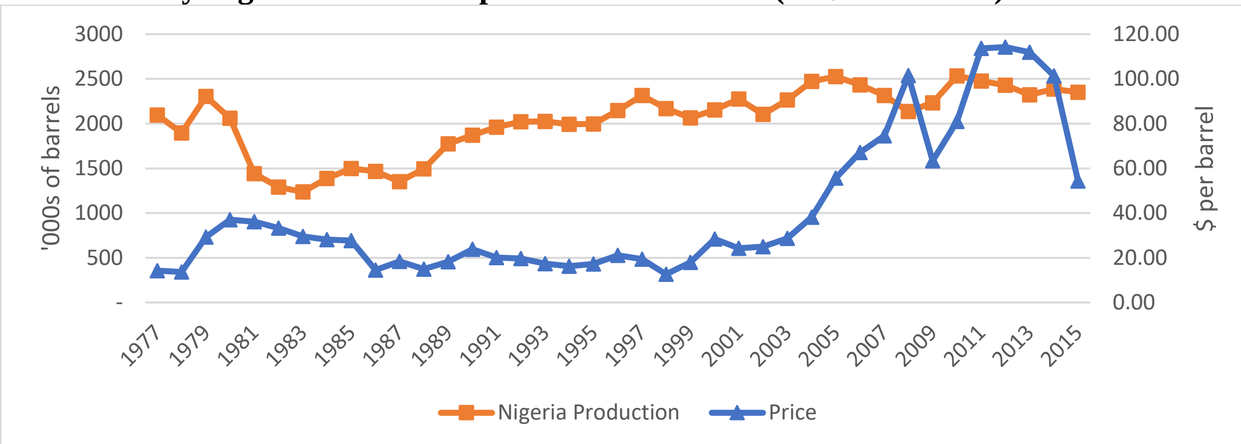


Source: Estimate from Statistical Review of World Energy 2016

As illustrated in Chart 5 below, oil prices are intrinsically volatile. The impact of price volatility on the country's financing is exacerbated by poor overall resource management, which, in Nigeria, has historically been presented as ineffective, unsustainable and a source of inefficiencies (Sala-i-Martin 2003).

Indeed, since the creation of the state-owned enterprise in 1977 - the Nigeria National Petroleum Corporation (NNPC) - expensive joint venture contracts between the NNPC and multinational oil companies have been the norm; however, this national oil company has been described as a source of inefficiencies. Its business model implies that the company is dependent on volatile government funding, resulting in a frequent lack of financial funding (Mähler 2010). As a result, the NNPC, unlike similar national oil companies of its size, remains a relatively small actor in oil-related operations, such as exploration and production. It principally acts as a regulator and supervisor for the Nigerian oil sector. This fact has undermined the country's capacity to build its development around a dynamic sector fully integrated into its development plans. This, it is argued, has deepened the sector dependency on foreign companies and has weakened Nigeria's capacity to capture higher margins, thus allowing significant repatriation of the sector's profits (Odularu, 2007).

Chart 5: Daily Nigerian Crude Oil production vs. Prices (US$ Per Barrel)



Source: BP Statistical Review, 2017 (for prices per barrel presented on the right-hand side) and Estimate from Statistical Review of World Energy 2016 (for daily production in thousands of barrels per day, presented on the left-hand side).

Nevertheless, oil revenues contribute significantly to government revenue; in absolute terms, oil sales have generated close to two trillion dollars. However, with a fast-growing population exceeding 186 million in 2016 (NBS data), resource revenues per capita remain very low. For example, in 2007, at the peak of the commodity super-cycle, Nigerian oil revenue per capita was estimated at US$391, while in Saudi Arabia, this figure was close to US$8,500. This relatively low figure partly explains the fact that in the Nigerian context, oil does not play the same stabilising or conflict-reducing role as it has in other top oil-exporting countries such as Saudi Arabia, further highlighting the importance of resource management.

Furthermore, high poverty rates were already predominant before the discovery of oil; however, they have increased drastically following the fall in oil revenues inflows in the mid-‘80s. The resulting economic crisis and structural reforms that followed have all been linked to the unstainable spending and management of these revenues. As a result, the country’s poverty rates increased from 35% to 70% between the 1970s and 1990s (Sala-i-Martin 2003: 35). In more recent times, these poverty rates[2] declined marginally by two percentage points between 2010 and 2012, to reach 33%; however, in absolute terms, given the country’s fertility rate, the number of Nigerians living below the poverty line has increased, and this, despite large oil revenue inflows.

[2] The Nigerian official poverty line is defined as the ability to consume at least 3000 calories per day.

In addition, Nigeria faces large regional disparities across a number of socio-economic indicators, including poverty rates. The South-West region, including the booming Lagos metropolis, reduced its poverty headcount from 21% in 2007 to 8.5%, in 2012. However, in the economically less dynamic northern part of the country, poverty remain high, at around 46% in the North-West region and 50% in the North-East region, reflecting a number of factors, namely relatively poor access to public goods, large infrastructure gaps, and the recent pervasive security instability.

3.3 Resources location within the Country

The Federal Republic of Nigeria owns the country's natural resources. The country is composed of 37 states (including the Federal Capital Territory), each of which is divided into local government areas. Thus, the 37 states are regrouped into six geopolitical zones and altogether there are 775 LGAs in the country. Oil is the main source of fiscal revenue in Nigeria and it is unevenly distributed across these geopolitical regions, with the South-South geopolitical region producing 98% of Nigerian's daily oil production of 2.5 million barrels in 2016. The oil production breakdown per state is presented in Table 2 below.

The South-South region, also known as the Niger Delta region, has a very difficult landscape composed of marshes, forests and creeks. These geographical characteristics fit the description of a "point resource" as described by Auty (1997) and Philippot (2010). The topography of this oil-producing region also underscores its vulnerability to oil exploitation and environmental damage, such as oil spills, which pollute local drinking water (Ukeje 2008).

The environmental damages observed from the early years of the exploration for oil are exacerbated by the unsustainable management of the resource and its environmental impact caused by both the multinational oil corporations and the government. Indeed, the UNDP has assessed that over three million barrels of oil have been spilled in the environment since the beginning of oil exploration, and only a fraction of that amount has since been recovered. (UNDP 2006: 76). Coupled with this is the fact that a large proportion of Nigerian gas is being flared (Lubeck et al. 2007). As a result, Nigeria has experienced large amounts of damage to its wildlife, as well as its local population and local economy, through air pollution, acid rain and noise, which have destroyed farmland and fishery activities.

More recently, Nigeria has experienced a gradual shift in production towards offshore oil fields: in 2016, these represented about 15% of total production (EIA,2017). Although offshore exploitation is comparatively more expensive than onshore exploitation, it has become more attractive to firms as they face increased risks of attacks on land-based oil facilities and overall insecurity in the region. This shift in production could lead to a reduction of the grievance-related conflict potential that Nigeria currently experiences in this region.

Table 2: Share of Oil Production Per State in Nigeria in 2015

States	Share of oil production
Rivers	21.50%
Delta	21.60%
Akwa Ibom	31.40%
Bayelsa	18.40%
Ondo	3.70%
Edo	2.40%
Abia	0.65%
Imo	0.35%

Source: Revenue mobilisation and fiscal allocation commission and Ministry of finance, 2017

3.4 Oil and Social Tension

The discovery of oil exacerbated social tensions in the region as redistribution of this new source of wealth was contentious. Its environmental impact also pushed local populations reliant on the fishing industry into economic hardship. These precipitated claims to independence in the Biafra region, which includes the main oil-producing states. This resulted in the Nigerian Civil War between July 1967 and January 1970. The two and half years of conflict resulted in about 100,000 military casualties and close to two million civilians dying from starvation (ICE case studies 1997). There are already several in-depth analyses linking the secessionist Biafra war to the control of oil rents, in addition to political struggles and ethnic tensions (Zinn 2005, Caselli, 2006; Kurečić, 2015). The presence of oil in this region undoubtedly contributed to this conflict (Ross, 2003).

Beginning in 1990 and continuing through the 1990s, this region of Nigeria was again prone to violence, (Abidoye and Cali, 2015), this time further exacerbated by the highest poverty rates in the country (Ross, 2003). During the 2000s, violence by rebel groups emerged in relation to demands for the control of a greater share of resource revenues. This violence was led by rebel groups and coincided with rising oil prices (Abidoye and Calì, 2015). Further, the violence in the

Niger Delta is linked to weak institutions and poor policymaking, as well as the perceived unfair treatment of the local communities in favour of foreign oil companies (Oyefusi, 2007). In addition, low incomes and education levels in the region have increased the probability of engaging in conflict (Oyefusi, 2007).

This development of the Nigerian political economy and its oil sector fits into the resource curse literature, which suggests that resource income and conflicts are positively related (Collier et al., 2004; Fearon, 2005). For instance, the literature indicates that a resource-poor country has a 0.5% probability of enduring a civil conflict; however, with an estimated share of natural resources estimated at 25% of GDP the probability of conflict increases to 23%. Nigeria's share of oil in GDP, before the GDP rebasing, was estimated at 9.2 % in 1970, increasing to 19.37 % in 1975 and reaching 37.4 % in 2009. It was averaging 12% between 2010 and 2016. This evidence is glaring for sub-Saharan Africa as resources such as oil (Fearon and Laitin, 2003; Ross, 2004; Humphreys, 2005), diamonds (Lujala, 2010) and other point-source resources increase the probability of conflict as they weaken states and serve to finance rebels (Collier and Hoeffler, 2004).

In addition, in the case of Nigeria, the race to control natural resources has been aggravated by the tense relationship between the country's different identity groups. The country is heterogeneous and presents deep ethnic, religious, and regional cleavages. Nigeria is a home to 513 languages, as reported by Tar and Shettima (2005). The Muslim Hausa-Fulani group is the largest (30% of the population) and is primarily concentrated in the northern part of Nigeria, followed by the Yoruba (in the south-west) comprising 20% of the population, while the predominantly Christian Igbo (in the south-east) represent around 16% of the population (Ukiwo (2005). The Niger Delta region (South-South) is constituted of several smaller ethnic groups, dominated by the Ijaw ethnic group (8% of the country's total population). It should be noted that even during the pre-oil era, these cleavages were the source of deep internal division in Nigeria. The resulting mistrust and lack of nationhood negatively affected Nigeria's stability, and its oil abundance has exacerbated this further – in particular in terms of the sharing of the resources (the voracity effect). The impact of such diversity on driving the resource curse has been highlighted by Di John (2007) and Rosser (2006), who also emphasised the role played in this drive by external factors, social forces and historical aspects.

Nigeria also presents symptoms of the “voracity effect”, negatively affecting growth, as has been observed following large revenue inflows from the resource sector in the context of oil-rich economies such as Venezuela and Mexico (Lane et al., 1996; Tornell et al., 1999). This effect can be described as the sum of rent-seeking behaviour developed in an attempt to control resource revenues, often in the context of weak institutions and poorly-defined property rights.

The historically weak political institutions in Nigeria’s post-independence have weakened the state’s ability to politically stabilise the country (Maehler, 2010). In addition, the already-weakened institutions have been further affected by a series of military coups, which strengthened the paternalistic characteristics of the political system. The military dictators, especially during the period 1985-1993 under General Babangida and the period 1993-1998 under General Abacha, found, in oil rents, an effective means to claim political legitimacy and assure the support of the country’s traditional rulers (for example, the chiefs or emirs), thereby encouraging a culture of rent-seeking and corruption. These features are still present in today’s Nigeria.

The Nigerian Federal Government collects resource revenues through the state-owned NNPC that executes oil production contracts between the Nigerian government and private oil companies. The voracity effect is particularly relevant here as it affects the allocation and spending of resource revenues, around which Nigerian politics is centred (Sala-i-Martin and Subramanian, 2013). For example, the proportion of oil revenue redistributed to producing states has been a source of intense negotiations; the revenue allocation rules have changed 18 times over the period 1970 to 2003, (Ross, 2003). The share of oil revenue allocated to oil-producing states changed from 45% to 20% in 1975, the share being further reduced to 5% in 1979. In 1999, with the return to democracy, the share was revised to 13%, which has resulted in a significant increase in revenues received by the producing states (Nigeria UNDP, 2006). This fraction comes in addition to the portion of oil revenue redistributed to every state (oil and non-oil-producing ones). In sum, the revenue-sharing formula indicates that close to 50% of oil revenues are redistributed to state and local governments. Furthermore, as the Nigerian budget is based on a reference oil price below market prices, excess proceeds over the budgeted revenue not saved in an excess crude account are redistributed according to the same formula.

The evolution of the share of resources allocated to oil-producing states in the South-South region indicates that those states were deprived of large revenues, exacerbating the already existing resentment towards the federal government. Nevertheless, changes under the 1999 constitution, with a share revised to 13%, implies that, compared to other states, the oil-producing states receive a disproportionally large share of the oil revenues. This revenue-sharing formula, implying that oil-producing states receive comparatively more oil revenues, reinforces the need to assess the local impact of oil on wages, given that oil-producing regions receive such a large part of the revenues (this is covered in more detail in chapter 5). Further, as discussed in the next section, the voracity effect can explain the lack of productive investment in the country, such as in infrastructure.

The Nigerian context is similar to that of Brazil, according to the findings of Caselli and Michaels' (2013) research which assessed the impact of oil revenue inflows on the local economy. Using municipality-related data, the analysis indicates that an increase of oil royalty receipts for municipalities results in increased local public spending. However, this spending impacts on local public goods minimally, with a limited effect on the quantity and quality of education, health services and housing. The impact is also not statistically significant on household revenues and population size. Caselli and Michaels concluded that an oil boom has a limited impact on a population's welfare; however, anecdotal evidence indicates that the resource inflows result in increased rent-seeking, with corruption and patronage practices increasing significantly. Brollo et al. (2013) align with these conclusions by comparing outcomes in oil-rich and other municipalities in Brazil. They confirm that revenue windfalls in Brazil are linked to more political corruption and embezzlement. This is very similar to the case of Nigeria, where, as described by Maehler (2010), revenue at the subnational level has not benefitted the population as a whole.

3.5 Fiscal Policy

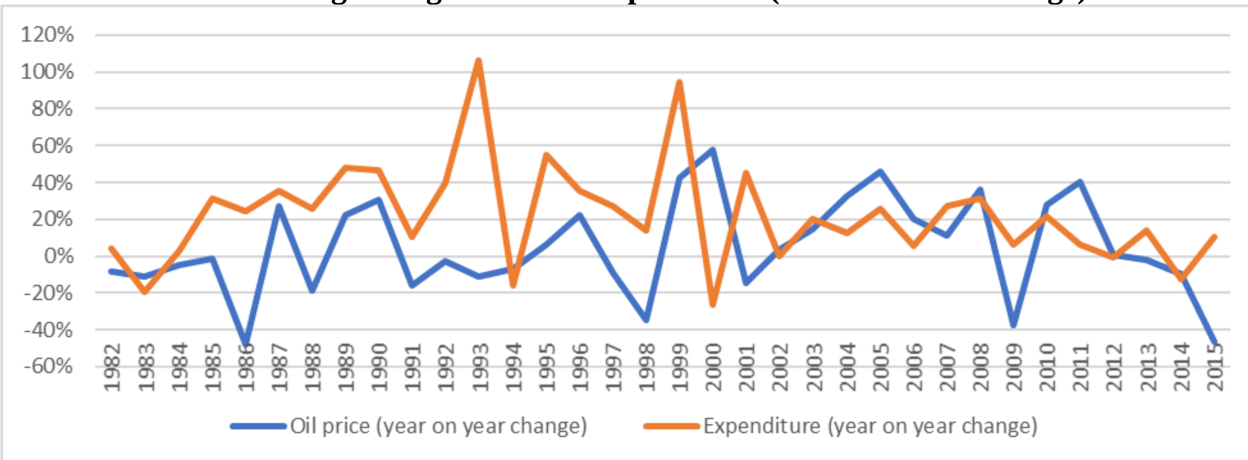
The abundance of oil in Nigeria is not only affecting the political economy of the country but also its macroeconomic fundamentals. Indeed, considering the period 1961 to 2000, Budina et al. (2007), in an analysis covering 90 countries, found that Nigeria was amongst the most volatile economies in terms of trade and exchange rate.

Nigeria's fiscal policy can also be described as volatile, and as being dependent on oil prices and revenues. Indeed, the share of oil revenue in federally-collected revenue increased from 26.3% in 1970 to 78.7% in 2009: this greater dependency implies greater volatility as it follows oil prices trends. During this time, Nigeria's public expenditure was highly correlated to revenues. Chart 6 below indicates that year-on-year expenditure growth correlates with the changes in oil prices. In line with oil price trends, public spending as a proportion of non-oil GDP (pre-GDP rebasing) grew significantly from 10% in 1971 to more than 60% in 1980. It then fell to around 20% in 1984 to reflect dwindling oil prices, before increasing again to 70% in 1990 and falling to around 30% in 1997. During the commodity supercycle in the 2000s, this share reached a peak of 80%, and has since stabilised at around 60% (CBN Statistical Bulletin, 2016).

The high fiscal-policy volatility reflecting the uncertainty in oil prices is in line with the "voracity effect" argument described above as different pressure groups will compete for their share of resource revenues resulting in overspending in periods of boom, and are highly likely to under-adjust in periods of bust. The different groups centred on their own interests avoid adjustment in periods of bust, leaving the adjustment costs to others (Lane and Tornell 1995), thus aggravating the volatility.

The volatility of expenditure is also correlated to unproductive public investments. Indeed, projects completed in a period of high resource revenues are unlikely to reflect the country's capacity to absorb them, thus at the end of a boom, the government will be unable to complete or maintain them. This has been a recurrent issue in the Nigerian context. Budina, et al. (2007), for example, indicate that the majority of projects completed between 1975 and 1989 failed to yield the expected returns needed to fast-track socio-economic development.

Chart 6: Oil Price vs. Nigerian government expenditure (Year on Year Change)

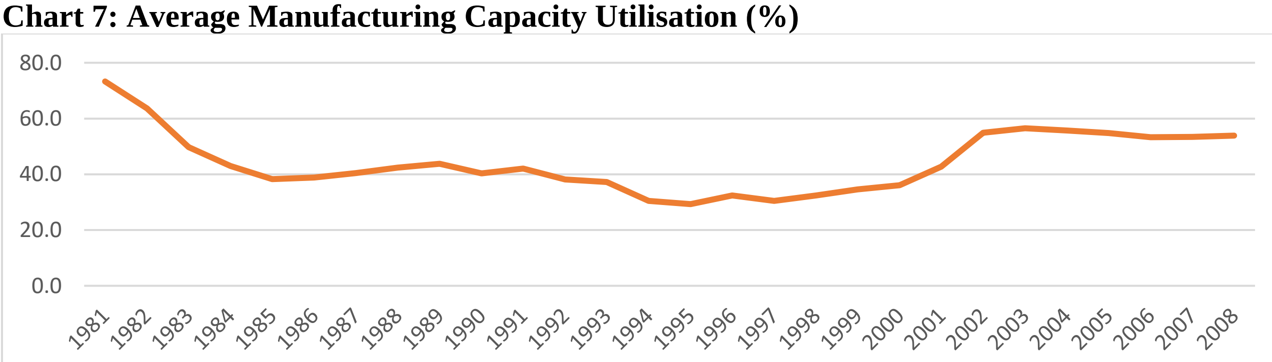


Source: BP Statistical Review, 2017 - for oil prices and CBN Statistical Bulletin (2016) – for total expenditure

A perfect illustration of this concerns the use of the oil revenue inflows in the 1970s which financed industrialisation projects and extended health and education services delivery across Nigeria. Unfortunately, these selected projects had a limited impact on the economic diversification efforts of the country as they were unproductive and conceptualised as a mechanism for spending the large inflows of revenue and to benefit certain groups close to the country's political circles (Mähler 2010).

This lack of productivity of investment is further reflected in capacity utilisation rates in the manufacturing sector. This rate averaged 77% in 1975, falling to 50% in 1983 (Chart 7). Between the period 1985 and 2000, capacity utilisation stagnated at around 45%, and it has been hovering around 55% ever since. Given that a substantial proportion of manufacturing capacity was owned by the government, it implies that only half of the investment in manufacturing has been productive. In summary, the Nigerian government over-invested in unproductive physical capital.

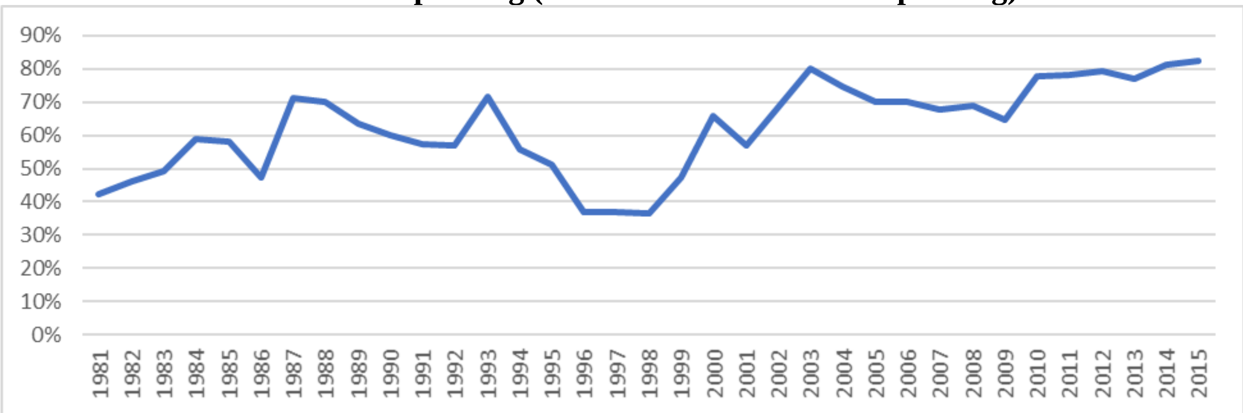
Chart 7: Average Manufacturing Capacity Utilisation (%)



Source: CBN Statistical Bulletin (2016)

Thus, the fiscal policy has resulted in quantity prevailing over quality, as described by Bevan et al. (1998: 67): "This conjunction of a powerful political impetus to public investment and a lack of civil service skill is what makes Nigeria's economic history in this period so spectacular: almost the entire windfall was invested, and yet [...] there was nothing to show for it". The inefficient and unproductive spending was also associated with increasing debt levels, which became an issue in the 1980s with falling oil prices and an increase in interest rates In addition, this corresponded to a shift in the public expenditure pattern, which placed a focus on consumption rather than investment (Chart 8 below), while money spent on administration expenditure (i.e. the costs of running the government) was more than three times the amount spent on the development of a productive economic sector, such as agriculture.

Chart 8: Share of Recurrent Spending (% of Total Government Spending)



Source: CBN Statistical Bulletin (2016)

The implication of these close links between expenditure and current income driven by oil is that in the case of an unanticipated drop in prices, downward adjustments are costly, and even more so considering that revenues are funnelled into subsidies or public employment (Segal, 2012). This is because Nigeria and many other resource-rich countries face similar issues in terms of access to capital markets. Indeed, a resource-rich country's borrowing needs are inversely related to oil prices; however, their borrowing capacity shows the opposite as a trend, as they can borrow more in times of high oil prices. Thus, oil wealth is *de-facto* used as collateral. Thus, access to external finance is more difficult when a resource-rich country is the most in need. As a result, these constraints deprive such countries of the ability to delink expenditure trends from volatile revenue inflows (Fielding, 1995).

Overall, Nigerian fiscal policies, instead of isolating the economy from the impact of resource price volatility, have compounded it. Despite an attempt in the mid-2000s through the creation of an excess crude account (ECA) and a sovereign wealth fund, public spending remains linked to resource-related revenues. The ECA is a special account which was set up in 2004 to protect the budget from unexpected shortfalls in oil prices. Thus, oil revenues in excess of the reference price are saved, isolating, in part, the economy from external oil-price related shocks. At its creation, the ECA was used to clear debt and reduce the required deficit in periods of bust. For example, by 2007, the ECA had built huge reserves, close to USD 10 billion. These allowed the government to smooth out expenditure as oil prices dropped significantly in 2007-2008. Since then, the ECA has been depleted as the account lost its credibility when the government could not resist political pressure to increase public spending when the oil prices recovered. The ECA was formalised through three sovereign wealth funds meant to manage Nigeria's excess earnings from crude oil.

In conclusion, as indicated by Budina, et al. (2007), fiscal policy has resulted in higher volatility levels beyond the levels of observed volatility stemming from variable oil prices; in other words, government policies have become a source of macroeconomic volatility. This excess volatility has impacted negatively on economic growth across the country’s different sectors (oil and non-oil).

3.6 Inflexible exchange rate policy and its impact on economic growth

Throughout Nigerian post-independence history, the impact of government spending volatility and increased aggregate spending on economic aggregates, including growth, has been accentuated by ineffective governmental monetary and exchange rate policies. In the Nigerian context, exchange rates were not flexible enough and this resulted in contributing to the boom and bust cycle which has characterised the Nigerian economy over the last 50 years, as described by Budina et al. (2006). Indeed, the exchange policy has oscillated between a fixed and flexible system, with capital control or government intervention playing a key role. Indeed, between 1960 and 1970, Nigeria operated under a fixed exchange rate system with a fixed parity set against the British pound and the US dollar (Obi et al., 2016). Towards the end of the 1970s, the Nigerian currency was tied to seven currencies, including the country’s main trading partners. The exchange rate policy before 1985 was set up to assure an overvaluation of the naira (N), with few restrictions on capital movement and a monetary policy used to defend the currency peg.

As part of the implementation of the structural adjustment programme (SAP) designed by the International Monetary Fund (IMF), a market-based exchange rate system was introduced in 1986, under the military regime of General Babangida (1985-1993), to usher in a realistic naira exchange rate, responding to market forces and able to stimulate non-oil exports (Mordi, 2006). This resulted in abandoning the currency peg, a more independent monetary policy and free capital movement. The currency depreciated quickly from 0.89 naira to one dollar in 1985 to 17.30 naira to one dollar in 1993, when Babangida left office (see Chart 9 below). In 1994, the fixed exchange rate system was reintroduced under the military regime of General Abacha (1993-1998). During this era (1994-1998), the currency peg was reintroduced and the naira was fixed at N21.89/USD, even though parallel markets indicated that it was overvalued, with the rate ranging between N56.80/ USD in 1994 and N84.70/USD at the end of Abacha's regime in 1998. Then, with the return of democracy in 1999, different governments opted for a guided/managed floating exchange rate system while allowing a measure of free capital movements.

In sum, the Nigerian exchange rate can be characterised by frequent changes resulting in high volatility, a real exchange rate overvaluation underlined by a continuous nominal depreciation, and the continued dominance of government as the main supplier of foreign exchange. Another key feature of the exchange rate policy is the large premium that exists between the official rate, determined by the authorities, and the parallel market rates, which reflect market forces. As a result, the RER was more stable during the fixed nominal exchange rate regime (1961-1985) than under the period of liberalisation that followed. The volatility was driven by the significant oil revenues and fiscal policy inconsistencies which were feeding high inflation (Ajao et al., 2013).

Given this context, several studies have analysed the determinants of the exchange rate policies, identifying a number of macroeconomic factors. Oil plays a significant role through the exchange in terms of trade; however, even under the fixed nominal exchange rate, the rates reflect several other factors. Sala-i-Martin et al. (2006) highlight that exchange rate movements are not fully dictated by oil prices as the correlation between real exchange rates and oil prices was only -0.05 over the period 1968-2000. Nwude (2013) presents a literature survey identifying a number of variables that impact Nigeria's short- and long-term real exchange rate. These include, among others: interest rate differentials, short term capital inflows, monetary policy, speculation, demand and supply regarding the naira, foreign exchange regulation and the general economic environment.

Indeed, among the substantial existing literature, Oriawota et al. (2012) identified inflation rates and capital inflow as the long-run determinants of real exchange rates, while terms of trade and fiscal policies did not have an impact over the period 1970-2010. Obi et al. (2010), by testing the Balassa-Samuelson hypothesis, found that increased productivity played a significant role in determining the exchange rate between 1970 to 2007. It also indicated that prices, investment levels and GDP are linked to exchange rate appreciation, while increased foreign reserves, interest rate differentials and degrees of openness were related to the depreciation of the naira.

Although the macroeconomic determinants are relevant in determining short- and long-run exchange rate levels, the role of the political economy cannot be ignored. Indeed, studies like Ibrahim (2016), covering the period from 1960 to 2015, bring together macroeconomic variables, such as money supply and the nominal exchange rate, as well as dummy variables representing specific periods of Nigerian history, such as a civil rule dummy, an SAP dummy and a change to civil rule dummy. The analysis indicates that the political regime in place is one of the major short-run fundamentals of the exchange rate, while terms of trade, capital inflows, trade and fiscal policies are the long-run fundamentals of the exchange rate in Nigeria.

Thus, as indicated by Sala-i-Martin (2006), the political economy factor is not negligible. Political considerations have played a significant role in influencing exchange rate policy and capital control measures in Nigeria. Indeed, the different, and sometimes conflicting, exchange rate policies in the country reflect the political dynamics. For instance, from independence to 1985, Nigeria adopted a regulated economic policy, ostensibly to promote economic development. However, this policy was in reality a mechanism to maintain low interest rates, a fixed exchange rate, controlled credit allocation, and protectionism, all related to some rent-seeking tendencies -(Okoye et al., 2016).

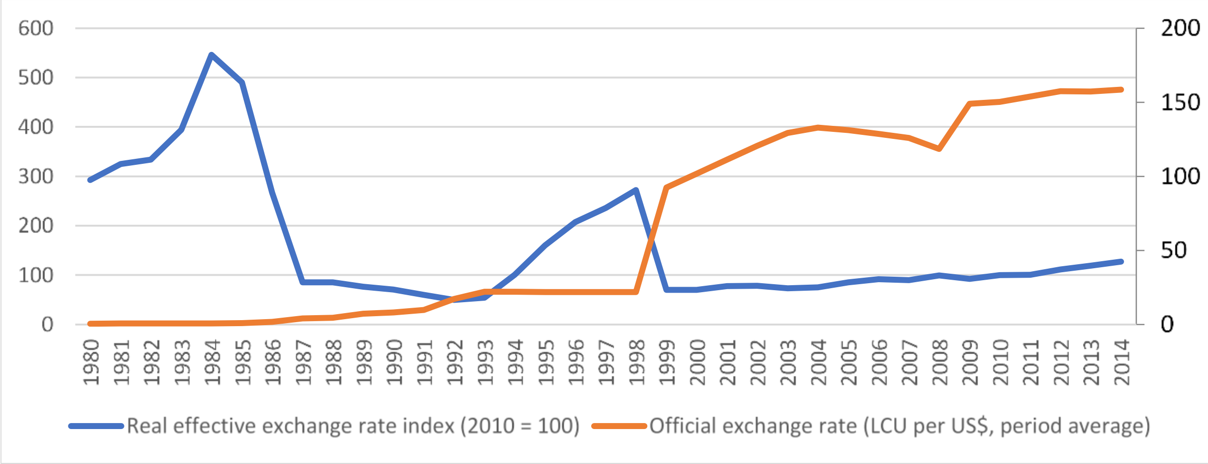
The political economy of the exchange rate also impacted the country's trade policies. Indeed, Nigerian exchange rate policies rested on protectionist trade policies in 1960 following the import substitution strategy adopted by the government, coupled with a worsening of Nigeria's terms of trade and a drop-in commodity price. Thus, government-imposed tariffs were set at a minimum of 50% on most imported goods, forcing an appreciation of the naira. In a period of high oil prices such as 1973-1980, the government substantially reduced tariff rates and followed an import payments policy to finance increased consumption driven by the DD's “spending effect”. These policies resulted in a large balance of payments disequilibrium. Over the period 1973-1978, the naira continued to appreciate, reflecting the expansionary fiscal policy and the deliberate currency appreciation policy. In the context of DD, the observed RER appreciation within the period is an efficient economic response; however, it was not sustainable under a fixed exchange-rate policy.

By 1980, at the end of the oil boom Nigeria had contracted a large external debt which grew annually by 72% between 1982 and 1985, reflecting its expansionary fiscal policy. Furthermore, to dampen demand and to maintain the appreciated exchange rate policy needed to maintain debt contracted in foreign currency at a manageable level, tariff rates in excess of 150% were introduced; similarly, quotas were a standard feature of trade policies. In essence, between 1960 and 1985, the RER appreciated because of the oil windfall but also because of government policies imposing trade restrictions and its large external debt. By 1986, this position was no longer sustainable, and Nigeria was forced to adopt a structural adjustment programme (SAP), aimed at restructuring and redirecting the Nigerian economy, promoting competition and raising the productivity of the real sector. However, a policy reversal occurred in 1994, as a fixed exchange rate system was reintroduced and most of the protectionist trade policy measures were reinstated to continue to fuel import driven consumption. With the return of democracy in 1999, the trade policy was aimed at protecting local industry while slightly reducing tariffs on consumer goods. This was intended to reduce smuggling and economic distortions. It resulted in increased tariffs with lower rates for goods and inputs scarce in the domestic market, and high rates for goods directly competing with local industry (Coste, 2014; Obinwata et al., 2016).

These trends in trade policy corresponded to a period of exchange rate depreciation as illustrated by Obinwata et al. (2016). The naira depreciated from N21.89/USD in 1998 to N92.69/USD in 1999, followed by further depreciation to reach N133.5/USD in 2004. This depreciation was linked to failing policies such as the creation in 1995 of a foreign exchange committee in charge of allocating foreign exchange. The economic conditions resulted in further depreciation and the dual exchange-rate market was reintroduced to manage this devaluation.

The exchange rate was relatively stable between 2004 and 2010, reflecting monetary policy reforms, such as financial sector reforms introduced in 2004, a reduction of exchange rate differentials between the different domestic markets, and the introduction of an effective monetary policy rate. As presented in Chart 9 below, these reforms were supported by large oil price increases resulting in an appreciation of from N132.15/USD in 2005 to N118.57/USD in 2008. This was followed by another depreciation driven by the financial crisis and the sharp fall in the resulting commodity prices. These are also reflected in the REER, which assesses a currency against a basket of other currencies. It is linked to the nominal exchange rate as nominal depreciation of the naira translates into weaker (more competitive) REER. Chart 9 below presents the REER and NER for the period 1960-2014.

Chart 9: The REER (Lhs) and NER (Rhs) for the Period 1960-2014



Source: World Bank Database

Note: The REER is the nominal effective exchange rate divided by a price deflator - an increase represents an appreciation. Nominal exchange rate refers to the exchange rate determined by legally sanctioned exchange market. It is calculated as an annual average based on monthly averages (local currency units relative to the U.S. dollar).

In addition, as pointed by Uruma et al. (2016), exchange rate policies are likely to be affected by varieties of political institutions, including election timing, since the real exchange rate affects broad aggregates like the purchasing power, the growth rates, the price level, and these broad aggregates are almost certainly relevant to elections. Indeed, governments, as in the case of Nigeria following the return to democracy, tend to maintain appreciated currencies before elections, delaying a depreciation/devaluation until after the election (Klein and Marion, 1997). Given the political unpopularity of a devaluation-induced reduction in national purchasing power, governments may face strong incentives to avoid devaluing, even when the result is a more severe crisis than would otherwise be expected, in order not to jeopardise their electoral fortunes.

As a summary, the exchange rate movements are linked to the multiple changes in exchange rate and trade policies adopted by the government in their effort to manage volatile domestic conditions linked to oil revenue inflows as well as a willingness to maintain an over-valued exchange rate to fuel import-driven consumption and in reaction to a complex political economy driven by rent-seeking behaviour.

3.7 Financial Markets and interest rate policies

There is a large body of literature pointing to the fact that resource-rich countries tend to have underdeveloped financial sectors. Bhattacharyya and Hodler (2014) indicate that this is relatively paradoxical given the large inflows of resource-related revenues. The literature has also advanced a number of underlying mechanisms of this other dimension of the resource curse. Hattendorff (2014) indicates that as resource-rich economies are more exposed to shocks, banks require high interest rates to reflect the risks. This negatively impacts the availability of credit; and, therefore, lowers financial development. Another argument relates to the fact that resource-related operations are often enclaves, as presented by Beck (2011). He established that the domestic banking system is underused by the resource sector as a significant proportion of their cost is paid abroad.

Another argument presented by Beck et al. (2010) points to the use of resource revenue: as investment in the resource sector increases, it may impact negatively on financial sector growth and reduce the viability of skills in that sector, given that the economy will start relying on the resource sector, which is less finance-intensive. Similarly, Nili and Rastad (2007) argue that investment, driven by government spending, crowds out the private sector and reduces the need for a developed financial sector. The argument that is most often put forward is presented by LaPorta et al. (1998) and Bhattacharyya and Hodler (2014); it points to the fact that the development of the financial sector is hindered by the quality of institutions and the ability to enforce contracts. Thus, the governance structure around the financial sector is too weak to favour its development. In resource-rich countries, these institutions are relatively weak, thus the risk associated with lending operation is much higher. This reduces the banks' willingness to lend. In this context, an elite having access to credit could use the proceeds from these activities to buy off political competitors. The resulting uncompetitive nature of politics reduces the incentives for fostering contract enforcement, and often fosters corruption.

Against this literature, Adekunle et al., (2013) indicate that during the 1970s and early 1980s, government intervention dominated financial sector development, which was seen as a means of guiding economic development. This intervention took the form of the government ownership of banks: the government controlled about 80% of assets in the commercial banks and 45% of assets in the merchant banks (Brownbridge, 1996; Umejiaku, 2011). In that period, the financial sector was described by Umejiaku (2011) as segmented and underdeveloped. The financial system was considerably over-stretched as government policies to direct bank credit to certain sectors at a concessional rate led to a distortion in the interest rate determination process, and also impacted negatively on the banks' balance sheets. Furthermore, the lack of appropriate regulation and prudential norms resulted in a large portfolio of non-performing assets (Obadan 2004). Indeed, interest rates were determined administratively by the Central Bank of Nigeria, thus failing to reflect markets forces. As a result, the correlation between the interest rate and oil price was only around -0.15, as can be seen in Chart 11 below.

During the period of direct control of the money supply, the interest rate policy was determined to direct financial resources at concessionary rates to the preferred sectors. On the other hand, the non-priority sectors faced above-market rates. Further interest rate policy was aimed at maintaining low debt service, and also to enhance output, following the devastation caused by years of civil war. It quickly became apparent that those measures affected the efficiencies of the sector, and resulted in financial repression, slower economic growth and credit benefiting an elite (Abu, 2010). It also resulted in an increase of non-performing loans and risk loans as banks had to grant credits on political rather than commercial considerations (Okonjo, 2018).This period of financial repression, coupled with the fact that the rates were significantly below the rate of inflation, implied that real interest rates were negative. This caused a decrease in savings, discouraged investment, and thus impacted economic growth prospects.

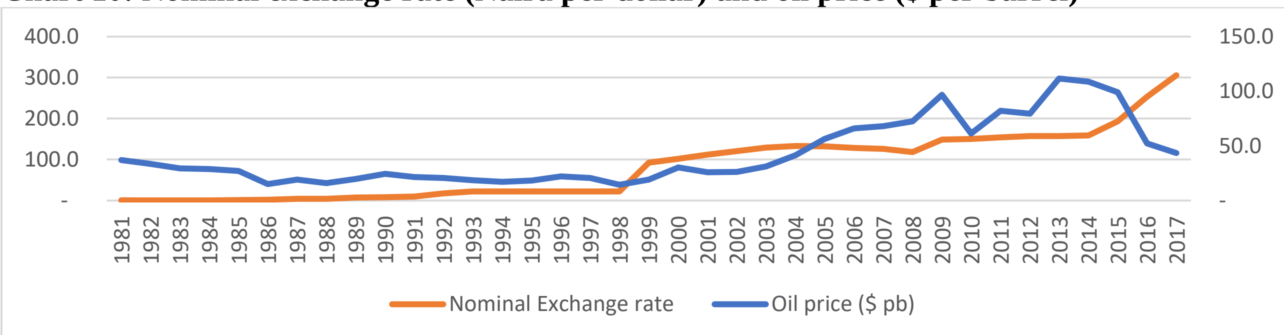
Since the mid-1980s, financial sector reforms have been pursued in Nigeria aimed at stabilizing and deepening the financial sector. A number of reforms, as highlighted by Somoye (2008), drove the development of the sector, including deregulation of interest rates, the strengthening of the regulatory and supervisory framework of the central bank, a review of the capital adequacy ratio, Bureau-de-Change guidelines, the privatization of government-owned banks, an increase in the range and type of bank accounts available, etc. As a result, the financial market deepened the money supply (M2), which stood at ₦16.1 billion in 1981, then increased to ₦700 billion in 1999, to reach 24 trillion in 2017. Credit to the private sector grew from ₦8.6 billion in 1980 to over ₦22 trillion by 2017. The deregulation of the financial sector also led to improved access to financial services (Adegbite, 2005) as the liquidity ratio declined from 94.5% in 1970 to 61.8% in 1972, and the lending-deposit ratio and ratio of bank credit to GDP rose from 51.3% and 6.7% to 74.2% and 8.7%, respectively.

Despite these trends, while some analysts argue that those reforms have resulted in increased sectorial performance and economic growth and positioned Nigeria as a competitive financial leader in Africa (Akingbola, 2006), others are of the opinion that the financial sector has not achieved much as the base of the industry has continued to remain fragile, playing but a supportive role to the public and private sectors (Okafor, 2012). This latter argument is linked to the role played by interest rates.

Indeed, interest rate policy has had an impact on the economic development of Nigeria. There has been an underdevelopment of the real sector and it has been claimed that the reason for this is the lack of funds from the financial sector to this sector. This ought not to be so because over long periods, there has been in most countries a rough but unmistakable parallel between economic growth and financial development. According to Gurley and Shaw (1967), there is clearly a positive correlation between levels of economic development and financial development. Among the wider literature covering Nigeria, Utile et al. (2018) found that inflation and exchange rates have a negative and insignificant effect on GDP, while the deposit interest rate exerted a positive and significant impact. Also, Osadume (2018) found that between 1986 and 2016, interest and monetary policy rates impacted growth both in the short and the long run. Moreover, Udoka et al. (2012) found that an increase in the interest rate will negatively impact GDP.

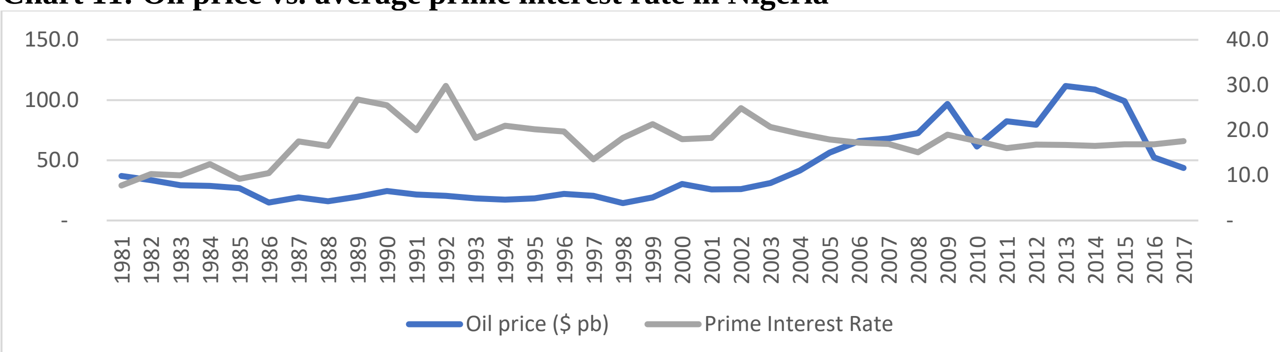
In sum, the discussion above indicates that both exchange rate and interest rate policies, to an extent, respond to some macroeconomic variables, but that the role of government policies cannot be understated. This can be seen in Chart 10 and Chart 11below, where interest rate and exchange rate policies are dissociated from oil prices. Interest rates in Nigeria before 2009 did not follow very closely the US federal reserve's bank rates. Furthermore, the interest rate and exchange rate show very little correlation, highlighting the lack of consistency of Nigerian policies over the years. Thus, the expected mechanism through which exchange rate impacts on growth and employment through the cost of borrowing (i.e. the interest rate) may be at play in the context of Nigeria, but it appears to be a relatively indirect relationship that needs to be further explored. However, this is beyond the scope of this thesis.

Chart 10: Nominal exchange rate (Naira per dollar) and oil price ($ per barrel)



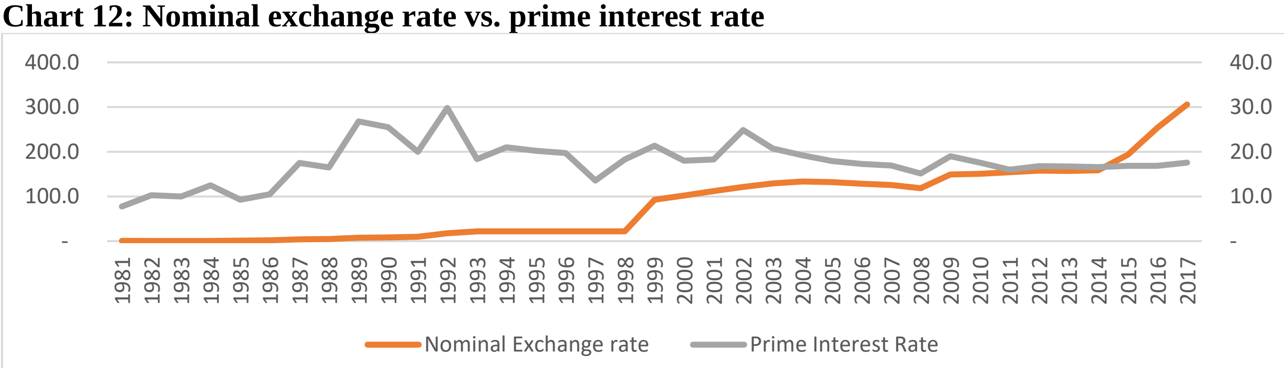
Source: World Bank database, accessed, July 2018 (Naira per dollars) – presented on the left-hand side and BP Statistical Review, 2017 (for prices per barrel presented on the right-hand side)

Chart 11: Oil price vs. average prime interest rate in Nigeria



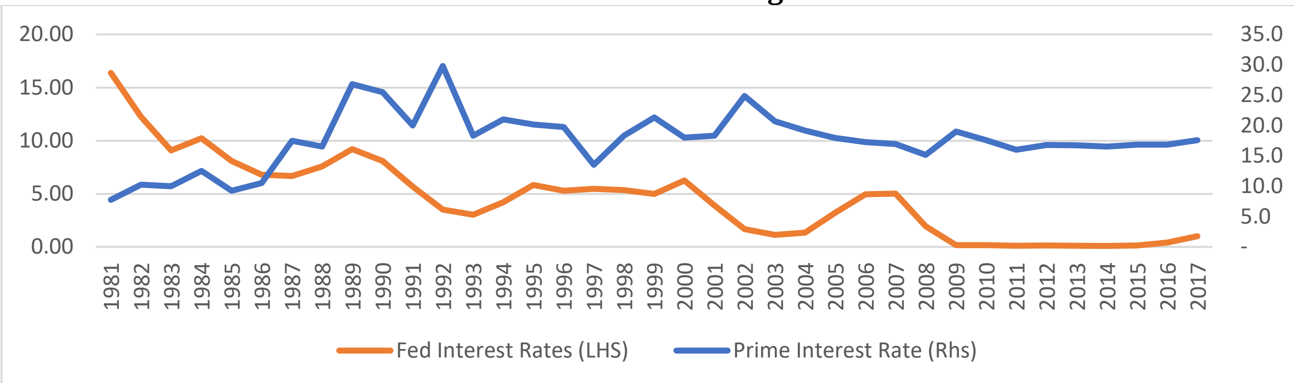
Source: CBN, statistical Bulletin, 2016 (average prime interest rate offered by Nigerian banks) – presented on the left-hand side and BP Statistical Review, 2017 (for prices per barrel presented on the right-hand side)

Chart 12: Nominal exchange rate vs. prime interest rate



Source: CBN, statistical Bulletin, 2016 (average prime interest rate offered by Nigerian banks) – presented on the left-hand side and World Bank database, accessed, July 2018 (Naira per dollars) – presented on the left-hand side

Chart 13: US Federal Reserve Bank Interest rates vs. Nigerian Interest rates



Source: CBN, statistical Bulletin, 2016 (average prime interest rate offered by Nigerian banks) – presented on the left-hand side and US Federal Bank reserve interest rate, sourced from the website in July 2019 – presented on the left-hand side

3.8 Economic Growth - Gross Domestic Product

Nigerian GDP growth, like most economic variables, has been relatively volatile. Indeed, following its independence, annual economic growth, measured by GDP, was around 3% during the period 1960-1970. This rate grew to around 6% over the period 1970-1978: the time of early oil production. In the early 1980s, Nigeria experienced negative growth rates, which turned positive with the structural adjustment programme, with an average annual growth of 4% between 1988 and 1997. Overall, despite the large revenue inflows throughout the first three decades of oil production, Nigeria recorded an average growth of less than 3% (NPC 2004). More recently, economic growth has accelerated significantly, as real GDP grew on average by over 7% between 2009 and 2014. This was before the negative growth registered in 2016 as a result of the sharp fall in commodity prices: real GDP fell from 6.23% in 2014 to -1.6% in 2016.

The composition of the Nigerian economic structure is clearly in line with the prediction of DD, which indicates that large oil revenue inflows alter the output composition via the spending effect, which contracts the agriculture sector; while the non-traded goods sector and the protected (semi-traded/semi-nontraded) manufacturing sector expand. Fardermesh (1991) studied a number of oil-rich countries, including, among others, Algeria, Nigeria and Venezuela, and found that an oil boom similar to the one experienced in the 1970s reduced agriculture output and resulted in an increase in non-traded goods, as well as manufacturing output (which in many developing countries is protected and not always tradable). Conversely, an oil collapse, as the one experienced in the 1980s, would promote agricultural activities and undermine manufacturing output and the non-traded goods sectors.

Structural changes in the economy brought on by the oil sector, which rose from 10% of GDP to 31% in 2000, while it employs less than 1% of the active population, had effects on other sectors. This is in line with the Dutch Disease prediction that the boom in the oil sector adversely affects outputs of non-oil tradables. Thus, Nigerian data indicates that in the 1950s, the agriculture sector accounted for 69% of GDP. The share quickly fell to about 49% and then below 20% by 1980. It has since stabilised around that mark (Sala-i-Martin et al. 2003). Before the rapid increase in oil export revenue, the country was exporting several cash crops, including cocoa, groundnuts, palm oil and rubber. However, production of these crops declined by over 75% between 1970 and 1981.

The agricultural contribution to GDP between 1981 and 1990 was 18%, and it rose to 20% in the following decade; this contribution also increased to 25% between 2001 and 2010 and decreased to 23% in the middle of 2011 and 2015. Its share in total foreign exchange receipts dropped from 86% in 1955 (Aigbokan, 2001) to 1.8% in 1996 (Balogun, 2001). These trends were attributed to two key factors, namely the large increase in oil prices and government policies meant to encourage industrialisation in the ‘80s and ‘90s, which had a negative impact on the sector. Despite the lower contribution to growth, the sector remains the largest employer of labour in the country. In 1970 the agricultural sector accounted for about 75% of the labour force; this gradually decreased to 59% in 1980’s and then later to represent about 57% in 2010, as illustrated by Table 3 below.

Low productivity and low investment have, in part, driven this performance. This is illustrated by the fact that only 34 million of an estimated 72 million hectares of potentially cultivable Nigerian land are in use (Norton, 1993). In addition, as indicated by Oyejide (1986), the macroeconomic developments of the country have driven this performance. Firstly, the rural-urban migration, which was driven by higher wage offers in other sectors, has put upward pressure on agricultural wages, resulting in sectoral wage increases in the ‘70s and ‘80s. This continued for most of the ‘90s. This is in line with DD and its impact on the non-resource tradable sector. In addition, trade policies, given their volatility and exchange rate policies, have also resulted in volatility and an overvaluation of the naira, reducing the profitability of the sector. (Kwanashie, Ajilima and Garba, 1998). The other non-oil tradable sector, the manufacturing sector, despite being the focus of several development plans and significant investment, has never really taken off (see Table 3) and has stagnated. In the Nigerian context, this is also reflected in the county's acute infrastructure gap crystallised by a significant lack of a reliable power supply, causing damage to firms' equipment. Thus, most private sector actors rely on self-supply for most public goods, using, for example, generators, thus increasing costs of production and negatively affecting competitiveness.

The other side of the observed decline in the agricultural sector concerns the growth of services (including the rapid rise of government spending in ineffective service delivery). The share of services grew from 34% in 1970 to 47% of GDP in 1980, by then the biggest contributor to growth. The decade that followed saw a relatively large decline in this share to 38%, before gradually increasing to 58% in 2015. Similarly, the service sector has attracted a significant share of employment. In line with DD predictions, labour is shifting from non-resource tradable activities to non-tradable activities.

Although in the Nigerian economic context, Dutch Disease is likely to be linked to the observed developments, such as services output and national income being positively correlated, its impact is potentially confounded by other factors. Take as an example the Engel effects in consumption: according to this theory, increasing income leads to increasing demand in services, linked to higher income elasticity of demand for services relative to agricultural products (Chenery et al., 1975, Syrquin et al., 1986). Another explanation could be Baumol's cost of "disease" effect: under this theory, the fast productivity growth in a sector such as oil allows for an increase in resources allocated to other sectors, in particular services (Baumol, 1967). Those impacts could confound the Dutch Disease resource movement effect.

As Rodrik (2014) argued, the capital intensity of the manufacturing sector reduces this sector's ability to absorb the large population migrating away from the agricultural sector, characterised by relatively low skills and low productivity. The extractive sector is capital intensive, generating little employment and high rents. The ILO (2005)[3] estimated that only 65,000 and 250,000 people respectively are working directly and indirectly in the Nigerian oil industry. The contribution is minimal given that the population consists of 180 million people. Thus, Rodrik (2016) argues that many developing countries are experiencing a premature de-industrialisation,

[3] Fajana, Sola. "Industrial relations in the oil industry in Nigeria." (2005).

as most of the excess labour from the agriculture sector is finding employment in low productivity service activities, such as retail trade or housework. This argument is central to the academic and policy discussions surrounding the ability of a services-led development model to provide jobs and accelerate economic development. On the one hand, Ghani and O'Connell (2014) respond positively to this possibility, arguing that services can deliver growth, while on the other hand, authors such as Rodrik (2016) and Kormawa and Jerome (2015) are more sceptical about the ability of the service sector to deliver decent employment as the service sector in developing countries operates at low margins and low levels of productivity.

Table 3: Composition of Output, Employment and Exports

	Share of output					
Sector	1970	1980	1990	2000	2010	2015
Agriculture	49	22	18	20	24	23
Oil and mining	10	25	36	31	15	10
Manufacturing	7	6	9	6	7	10
Services	34	47	38	42	54	58
	Share of employment					
Sector	1970	1980	1990	2000	2010	2015
Agriculture	75	59	58	57	30.6	36.4
Oil and mining	0.2	0.4	-	-	-	-
Manufacturing	15	17.7	9.2	9.1	14.1	11.8
Services	9.8	22.9	32.2	34	55	52
	Share of exports					
Sector	1970	1980	1990	2000	2010	2015
Agriculture	71.9	2.4	1.46	0.14	3.34	4.75
Oil and mining	15.4	87.5	97	99	94.4	92.2
Manufacturing	12.7	0.1	1.54	0.86	2.26	3.05
Services						

Source: Computed from CBN Statistical Bulletin, 2016

The above discussion is even more applicable to the recent trends showing that Nigeria's non-oil sector has experienced significant growth. In the 1990s and early 2000s, the significant increase in oil production resulted in relatively low and unproductive investment in other sectors. Nevertheless, the data indicates that since 2003, 70% of growth originated from non-resource sectors such as agriculture, and services such as trade-related activities. This was emphasised by the National Bureau of Statistics (NBS) GDP rebasing exercise undertaken in 2014, which reflected the economic transition that Nigeria had experienced, as the country became the richest on the continent, with a revised GDP estimate of USD510 billion in 2013. Following this exercise, economic activities can be seen to be more diverse, with increased contributions from service sectors, previously largely informal and undocumented, such as the entertainment industry. In addition, emerging services, including construction, financial intermediation, and ICT, have also contributed significantly to economic growth, illustrating the structural transformation and a shift of economic activities towards services – as predicted by the Dutch Disease framework.

In conclusion, large revenue inflows have impacted on the economy, mostly in line with the prediction of the DD framework. Oil continues to matter in the development of other sectors in Nigeria. Indeed, Akinlo (2012) analysed the role of oil in the development of several other economic sectors, including manufacturing, agriculture, trade & services, as well as construction, using a multivariate vector auto-regression (VAR) model covering the years 1960 to 2009. He concludes that the five different sectors are co-integrated and that the resource sector can positively impact the growth of the trade sector, while this impact turns negative concerning the manufacturing sector. This is in line with the predictions of DD.

Although oil matters, a major concern with the country's growth pattern includes the weak linkages between the oil sector and the rest of the economy. Ibrahim (2007) explains this lack of integration by the lack of technological development in other sectors of the economy, further exacerbated by weak downstream oil activities. Thus, in this context, growth differentials in oil and non-oil sectors are inevitable, as the oil sector operates as an enclave not integrated with the rest of the economy. Therefore, for example, it will not support the growth of the manufacturing sector (Ibrahim, 2007).

Furthermore, employment and GDP are weakly linked. For example, agriculture represents 22% of GDP but employs 50% of the population, while industry represented 27% of GDP in 2012 but only employed 6% of Nigerian workers. Therefore, the current growth pattern is unlikely to increase household incomes and reduce poverty. Indeed, being employed does not translate into maintaining average living standards, as a large number of jobs are informal and very often associated with low skills and productivity. These forms of employment support livelihoods but do not provide sufficient income to reduce poverty in Nigeria, and do not support structural transformation through productivity growth. Nor do they build self-esteem or social cohesion

(World Bank, 2015). The discussion below links the macroeconomic developments in Nigeria to the structure of the labour market.

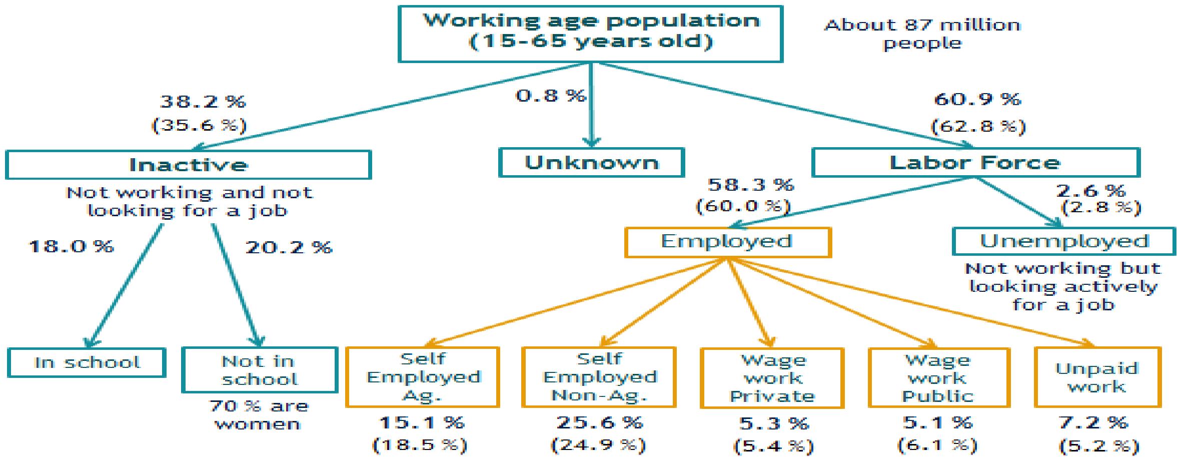
3.9 Composition of the Nigerian Labour Market

Nigeria is the continent's most populated nation, with a population estimated at over 158 million in 2011, of which over 50% or 87 million people are aged between 15 and 64 years old. In this group of working-age adults, only 5% are categorised as not working but actively searching for a job: i.e. unemployed. According to the ILO definition of unemployment[4], Nigeria's unemployment rate is low, but this masks the fact that the labour market is dominated by very low productivity sectors such as agriculture and services (i.e. the retail trade) (World Bank 2014). Indeed, while the total labour force rose by 3% on average between 2010 and 2014, the share of the active population in paid employment increased on average only by 2% over the same period, three times and eight times lower than the growth observed in underemployment and unemployment, respectively.

In addition, according to the World Bank and the Nigeria Jobs Report (2015), the Nigerian labour market is dominated by informality. While two-thirds of the adult population work in the labour market, self-employment in agriculture and non-farm activities accounts for 70% of employment. These sectors are generally described as informal sectors, where workers have no employer and generally lack access to any form of social security. Only nine million out of a working population of 87 million are employed in either the private or the public sector. Chart 14 below also indicates that employment patterns are slowly shifting away from agrarian self-employment to other activities. Only one in 20 workers in agriculture are wage labourers, with the rest being engaged in smallholder farming.

[4] Nigeria's Bureau of Statistics is using a specific definition of the employment presented as the labour force share able and available to work, but that work was less than 39 hours in the week preceding the survey. As a result, compared to the international definition, the unemployment rate across Nigeria has been very high.

Chart 14: Composition of the Nigerian Labour Market in 2011/12



Source: Adjusted from estimates World Bank based on GHS 2010/11 and GHS 2012/13.
Note: Numbers in parentheses correspond to the estimates for 2010/11. Wage work Private includes private firms, NGOs, cooperatives and international organisations. Wage work Public includes federal, state and local governments.

Despite a fall in the share of employment in agriculture, a large share of households rely on farming for employment and income, even in peri-urban areas. However, the sector is characterised by low productivity, with little access to agricultural inputs such as fertilisers, pesticides or draught animals: less than 10% of workers have access to irrigation, and less than 15% benefit from agricultural advisory services. This links to Nigeria’s public expenditure pattern, with very little investment in the productive sector (section 3.5 above). Given the low productivity in the sector, many households cannot rely on their farming income alone (one in five of those employed has a second job, mostly as a self-employed person). Nevertheless, 40% of rurally based farm households are poor, compared to 19% of households who have completely diversified out of the agricultural sector, and 31% who mix farm and non-farm activities in order to supplement their income (Oseni et al 2014).

In addition, the country presents some strong regional disparities. The share of employment in farming is in fact higher in the northern regions, where the semi-arid climate is less favourable for cultivation, than in the southern regions. Conversely, one in four households in the South-East engage in higher market value cash crop production, compared to only one in 100 households in the North-East, in line with the higher poverty rates in the northern regions as compared to the southern region of the country.

Unlike many other African countries, the net effect of workers moving out of agriculture has not led to an increase in the household enterprise sector. Instead, more jobs have been created in the private, and especially the public, wage sectors, which constitute higher rates of employment of non-farm workers in the formal sectors of Nigeria's economy. Wage employment represents 18% of total employment, of which 50% are employed in the public sector. The public sector contribution to wage-work explains why the government spends so much on recurrent expenditure every fiscal year, and hints at the fact that the public sector is crowding out the private sector by setting up wages and attracting the best talent, similar to the experience of the Middle East and North-Africa regions (Segal,2012; Behar et Mok, 2013). Overall, the World Bank World Development Indicator indicates that the size of wage work is very small compared to other regions, such as South-East Asia, as wage sector employment in Indonesia and the Philippines were estimated at 40% and 57% of the active population, respectively. Further, public sector employment as a share of the active population went from 6% to 5% between 2011 and 2013 resulting from the privatisation of several sectors of the economy such as the telecommunication, banking and energy sectors.

In terms of unemployment, the rates are higher for the more educated, reaching 10% for those with post-secondary education. In fact, only 11% of the population has some post-secondary training, but they account for 21% of the unemployed. As in many African countries, unemployment is also a more significant problem for those with higher education, especially for women, who may not be able to find jobs that match their expectations or education when compared to those with little schooling. It follows that unemployment, unlike inactivity, is not prevalent among the poor, who cannot afford to be unemployed. In fact, the youth belonging to the richest 40% of the population are overrepresented among the unemployed.

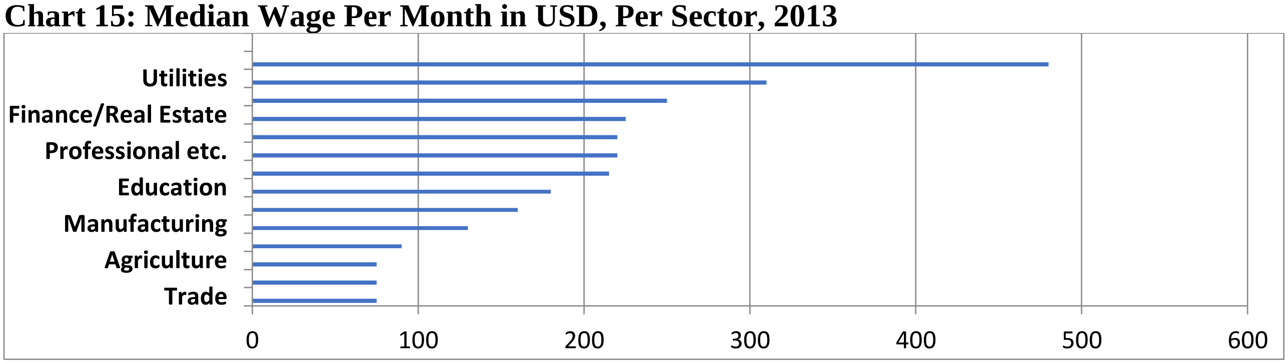
3.10 Labour Market and Wages

The Nigerian labour market structure does not support poverty reduction efforts. In fact, the poor and the non-poor are about as likely to be working and employment-to-population ratios are not markedly different across consumption quintiles. Instead, the sector of activity is a stronger indicator of poverty patterns, most visibly for the poorest and the richest Nigerians. Half (51%) of those working in agriculture belong to the poorest 40% of the population (the two poorest quintiles). They are under-represented in the non-agricultural sector, where poor workers account for only 34% and 27% of self-employment in industry and services respectively, and only 17%

of the public-sector workers are from the two poorest quintiles. In contrast, the richest 20% account for nearly half of public sector employment, and for 40% of private wage work.

The patterns of poverty and the working sector are closely linked to variations in income. Within the wage sector, income opportunities differ significantly according to the sector of work, with urban-based, formal and public-sector jobs paying best (see Chart 15). The natural resource sector, drawing on oil rents, offers by far the highest wages. The construction sector, which has expanded rapidly in recent years together with an oil-driven real estate boom, along with the real estate/finance sector, have the highest wages. Health, which tends to be public sector, and utilities are also at the high end of wage earnings. These reflects the growth patterns discussed above (Table 3 above). By contrast, private sector-based activities like transport, personal services, and trade, which tend to be more informal and run on a small scale, pay much less.

Chart 15: Median Wage Per Month in USD, Per Sector, 2013



Source: Estimates based on Health Survey 2013

3.11 Regional Disparity in Terms of Economic Activities

Beyond the general structure of Nigeria's labour market, the population's economic activities are also unequally concentrated across the country, with the southern part being the most dynamic, with the exception of the Kano hub in the northern part. Although economic activities in central and northern regions have converged towards the level of the south this trend has been slow, and southern Nigeria remains the most economically dynamic part of the country, apart from a few enclaves such as Abuja, Kano, Kaduna, Jos and Sokoto.

Uneven economic development may exacerbate ethnic and regional tensions across the country, in particular in the resource-rich context (i.e. the voracity effect). Nigeria's key resources (oil and gas) can be found in the South-West of the country, along the Niger River delta (Igbo territory), which receives more revenue from the revenue sharing formula, while the Kano-

Kaduna axis (Hausa/Fulani territory) has long been a corridor for traders and merchants coming from the Sahel. The South-West, meanwhile, has been driven by the megapolis of Lagos. With the exception of these few pockets, most of the country has been economically stagnant.

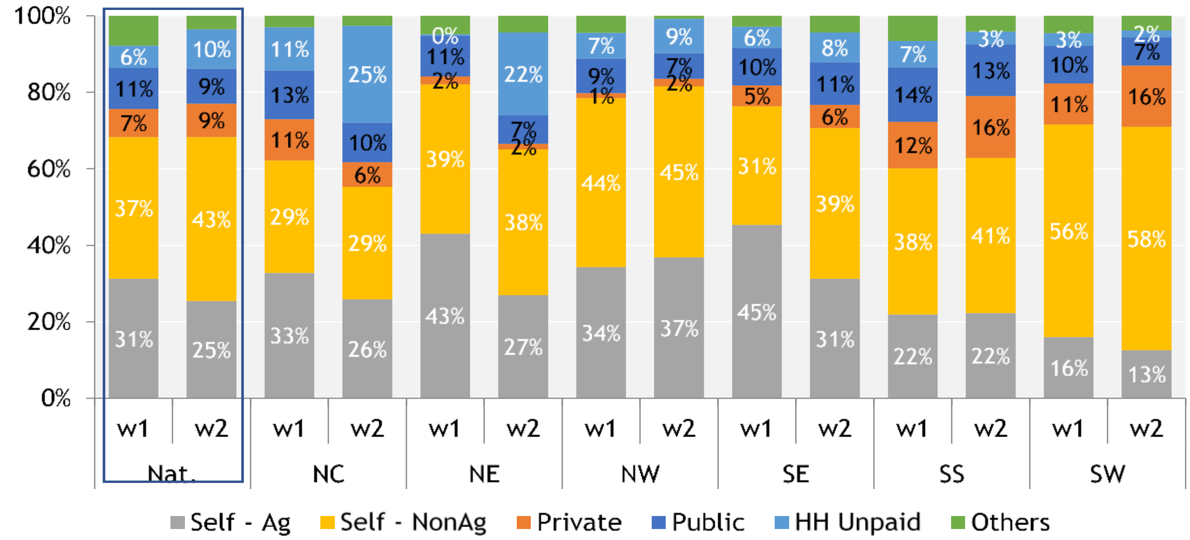
The existence of a strong ethnic identity and social networks within the different ethnic groups in Nigeria implies the existence of fragmented markets characterised by high transaction costs. Indeed, Fenske and Zurimendi (2015) highlighted how oil prices impact populations, and a number of socio-economic outcomes, such as education, employment, and wealth, differ depending on ethnicity. In addition, Aker et al. (2014) point to the existence of lower business transaction costs when traders belong to the same ethnic group. These evidences indicate that the strong ethnic division existing in Nigeria can result in fragmented labour and supplier markets, resulting in limited mobility. This aspect of the Nigerian labour market is particularly interesting for studying the wage-determination process and the role of oil in this process (chapter 5)

With the main economic activities located in the South, the wage-work sector is also larger in this region. The occupational choice of the working-age population differs by region, as shown below. The share of wage work in total employment corresponds to 29% and 23% in the South-South and South-West regions, respectively (Chart 16). This share is significantly higher than the equivalent proportion in the North-East and North-West regions, estimated at 9%. Across the different zones, the share of public sector employment has decreased; while private sector employment has been growing in the southern regions, it is almost non-existent in the north.

Like other social and economic metrics, poverty rates are higher in the north, with an average of 67%, which is almost three times the rate in the south and more than one-and-a-half times more than the national average of 45.3%. The poverty rate differences between the north and south boil down to the fact that economic activities in the north are characterised by very low productivity, low consumption levels, higher population (growth) and less industrialisation, which is not as prevalent in the south. In sum, this makes the north region a poorer and less productive region in comparison with the south.

Chart 16: Distribution of the Employed Labour Force, Per Type of Employer

For wave 1(2010/11) and wave 2(2012/13)



Source: HGS survey and adjusted from World Bank (2013).
Based on answers to the question: “In your main activity, what is the employer in this job?” and “Have you received wages, salary or other payments either in cash or in other forms from this employment for this work?”

3.12 Labour Demand: A Picture of the Private Sector

Nigeria is home to about 37 million enterprises, most of which are microenterprises, and about 40% of which are farms (SMEDAN, 2012). According to SMEDAN, there were also about 68,200 small firms (between 10 and 49 employees) and 4,670 medium firms (with more than 50 employees) in operation in Nigeria in 2012. This indicates that most Nigerians have informal jobs, defined as wage-workers working without a contract, and are self-employed/household enterprise workers in firms that are not registered with the authorities. Some 96% of the self-employed who work on their own farms and 84% of the self-employed in the non-farm sector are not registered with the authorities. In 2011, about five in six non-agricultural wage workers were informally employed.

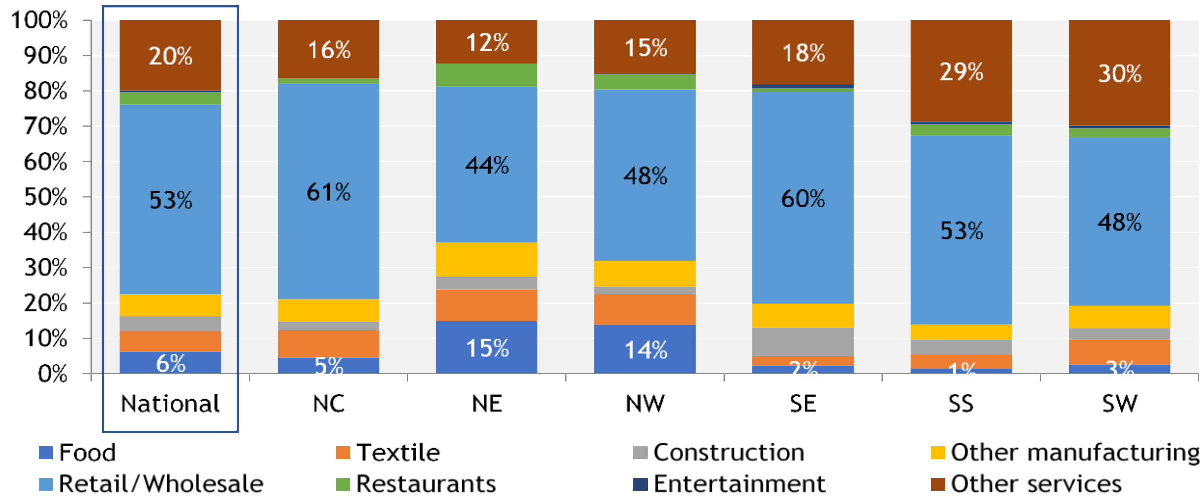
The level of informality is highest among services sector workers. While private-sector jobs are almost exclusively (96%) informal, three out of four public sector workers are also informally employed. Informality is “normal” at this stage of development – indeed, in many countries in Latin America and East Asia, informal employment in fact increased with growth (OECD, 2009; Perry et al., 2007). As such, informality is not likely to fall with economic development and the share of informal employment will not be a good indicator of changes in job opportunities.

3.12.1 Informality and Non-Farm Enterprises (NFE)

Another key characteristic of informal economic activities in Nigeria is the importance of non-farm enterprises (NFEs). As in many developing economies, NFEs reflect economic needs and the fact that the private sector fails to provide decent alternatives. Similarly, in other sub-Saharan African countries, including Tanzania and the Republic of Congo, NFEs originate with the inability to find wage-employment (Fox, L. & Sohnesen, 2012) and remain a major source of income for the poorest households (Haggblade, Hazel and Reardon 2007). Household-based activities outside of agriculture provide complementary income to rural farm-based households and are the most important form of activity in urban areas, above wage employment. In the South-West region, household enterprises account for more than half of all jobs; even in the northern regions, which remain dominated by farming, one quarter of the employed are working in a non-farm household enterprise as their primary job. In rural areas, many workers also shift between farming and household enterprises on a seasonal basis. Overall, 63% of all households were involved in an NFE, underlined by strong regional disparities with the South-West and North-West geopolitical zones, accounting for over 50% of the NFEs in Nigeria. Most of these businesses are not professionally run, and almost all operate without registration. They are also run from home (over 50%), employ on average 1.5 persons (including the owner) and very few of them (9%) employ labour outside of the household.

In line the with the country’s growth pattern, most of the NFEs provide services, the majority being in retail, trade or personal services, although they are venturing into manufacturing goods as well. NFEs cater mainly to local customers and not to other businesses. NFEs, as a whole, are dominated by wholesale and retail services; while the manufacturing sector accounts for almost one-fifth of NFEs, the production of food-related products dominates. The overall landscape of NFEs varies across the country (Chart 17 below). Only 6% of these firms are registered. They have little access to formal means of financing and rely on household savings or the extended family for start-up capital. The median income of a household enterprise is approximately 30 USD per month (National Bureau of Statistics, 2013) – less than one-quarter of the manufacturing median monthly wage (about 134 USD).

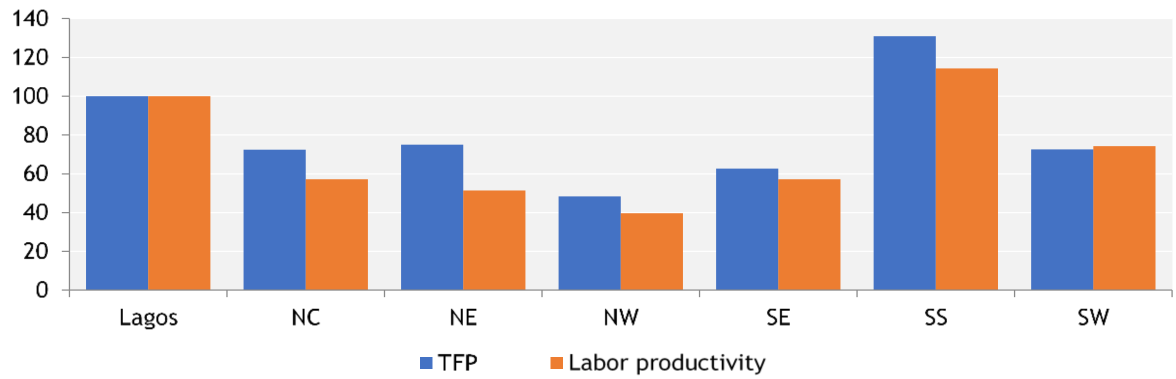
Chart 17: NFE Distribution per sector and region



Source: Estimates based on GHS 2012/13

Firms in the economic hub of Lagos and in the South-South geopolitical area display greater productivity than in other parts of the country, in terms of total factor productivity (TFP) and labour productivity (Chart 18). Firms in the North-West geopolitical region are the least productive (displaying productivity levels of about 50% of the median firm in Lagos), while other regions present similar levels of productivity. There is no great difference in terms of NFE productivity between sectors; however, in line with DD, wage-per-worker in the services sector is higher than in manufacturing.

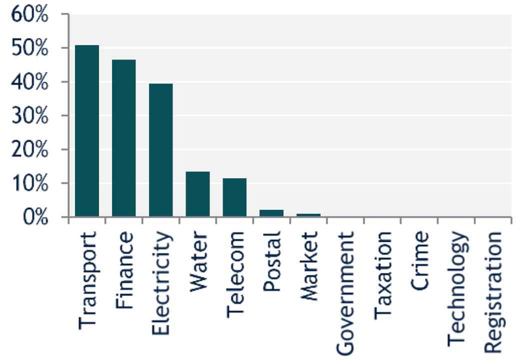
Chart 18: Median Labour Productivity and TFP Compared to Lagos Median Firms



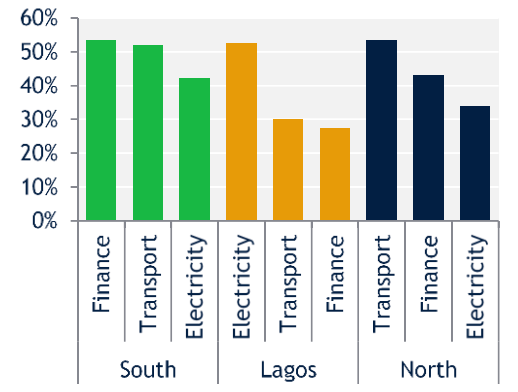
Source: World Bank calculations based on GHS 2012/13.

Part of the performance of an NFE is linked to the current business climate (see Chart 19, below). Transport, finance and electricity were assessed as the top three obstacles to a firm’s growth, followed by significant difficulty in gaining access to water and telecommunications. Although the Nigerian government incurs huge expenditure every year, it is largely recurrent, and little is expended on infrastructural facilities to ensure it has good transportation electricity or telecommunications networks , and access to credit facilities comes at a great cost – such as collateral security, high commercial bank interest rates, which are above 25%, surety and other strict conditions that business owners cannot meet.

Chart 19: Key Bottlenecks Faced by NFEs (LHS) and Top Three Obstacles by Key Zones (Rhs)



Source: World Bank (2013)



Source: World Bank (2013)

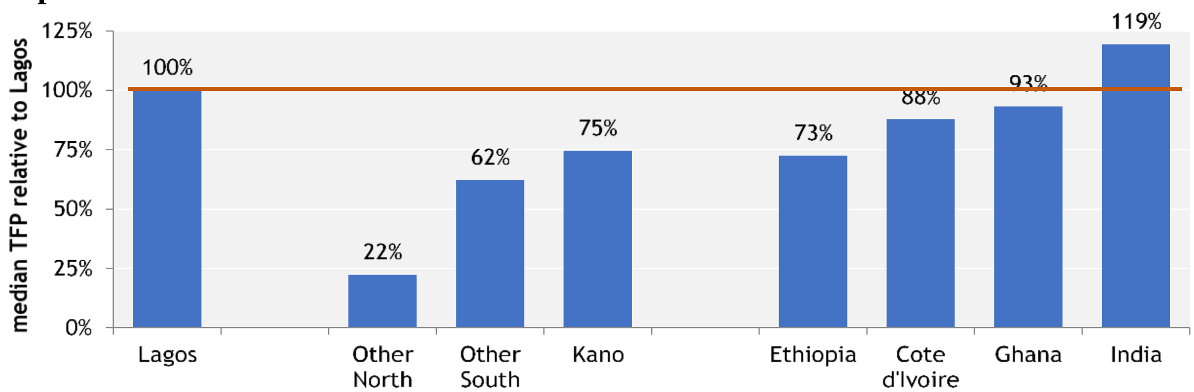
3.12.2 Unproductive Formal Sector

Although informality is normal for the level of development in Nigeria, a more vibrant formal sector could support efforts to reduce poverty and foster growth. As detailed in the Nigeria Jobs Report (2015), the wealthiest top 20% of households represent about 40% of private wage employment, implying that receiving a wage increases the prospect of exiting poverty when compared to the agriculture or informal sectors. However, this sector employs less than 9% of the working population in Nigeria.

In order for Nigeria to develop this sector, company performance must improve. An underlying factor responsible for the sluggish performance of the formal sector concerns the way in which growth, in general, has been driven by the fast accumulation of capital and labour, rather than by an increase in productivity. This is coupled with the fact that there is a lack of dynamic firms in Nigeria (see Ramachandran et al. 2013). Indeed, total factor productivity (TFP) in the country is comparatively low, and lower than expected given its per capita income (World Bank 2016).

The low TFP in the country (Chart 20) in part reflects the regional disparities and low productivity in the northern part of the country. Firms in Lagos are particularly productive and compare well with firms operating in Ethiopia, Côte d'Ivoire and Ghana. Although TFP in Lagos is lower than in India – and the other BRICS – it compares more favourably with these firms as well. The median firms in Kana and Kaduna present productivity levels of 75% of the medium firms in Lagos, while firms in the south stand at 62%. The difference between other northern provinces and Lagos and other regions is more significant. TFP in the northern provinces accounts for one-third of TFP in the southern provinces, and one-quarter of TFP in Lagos, thus, pushing the national average downwards.

Chart 20: Median Manufacturing Firms' TFP in Lagos against other Regions and Comparative Countries



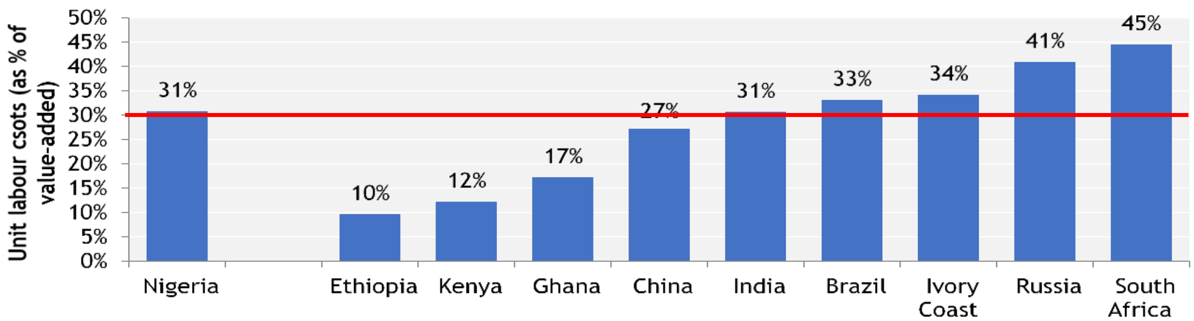
Source: adjusted from World Bank report.

Firms in Nigeria remain labour intensive. Unit labour costs are high, but TFP is relatively low. This implies that, despite the high cost of each unit of labour and high productivity of each unit of capital, firms are still reluctant to invest in more capital and that production processes remain labour intensive. Weak property rights, infrastructure deficiencies (such as a lack of roads and electricity- see below) could explain why firms are reluctant to invest more in capital. In addition, low productivity is also linked to labour productivity (Clarke, 2011). The low wage rates in the country do not adjust to reflect the low labour productivity levels, and this results in lower competitiveness compared to other countries. This may be due to the rigid labour market, which forces businesses to retain poor performers. A lack of investment in human capital and/or a skills mismatch are further possible reasons for this. This provides a further rationale to look at the determinant of wage and wage inequality, which this project seeks to investigate.

Indeed, unit labour costs are high in Nigeria; labour costs about 31% of output. Only Côte d'Ivoire (34%) and South Africa (45%) have higher unit labour costs (see Clarke et al., 2007). However, Nigeria's unit labour costs are only marginally higher than Chinese costs (27%) and comparable to Indian (31%).

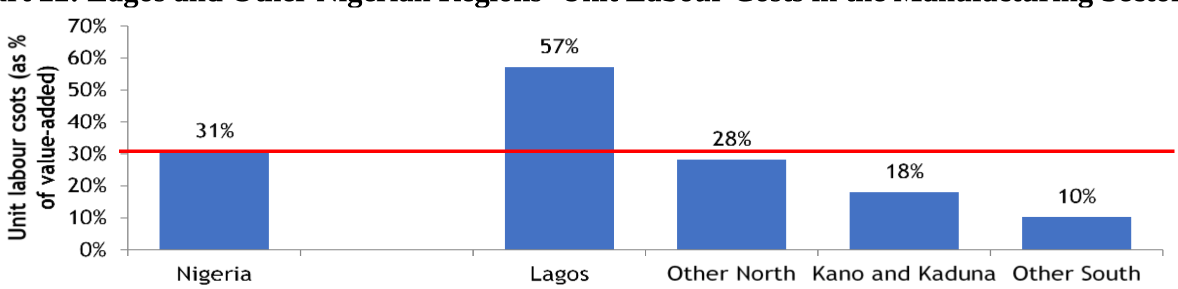
Costs of labour display large regional disparity. In Kano and Kaduna and in the south, they are comparable to countries with the lowest unit labour costs (see Chart 21 below), giving firms in these locations a clear comparative advantage in the production of labour-intensive goods. In Northern Nigeria, low productivity is met by low wages. In contrast, unit labour costs appear relatively high in Lagos: at 57%, they are higher than other countries (see Chart 22 below). Chapter 5 on wage determination will argue that wages could be even more competitive in the absence of oil in the South-South region. In addition, the chapter will present evidence of the role of oil revenue in explaining wage inequality across firms.

Chart 21: Nigerian Unit Labour Costs in the Manufacturing Sector against Comparative Countries



Source: Adjusted from World Bank ES (2014/15 for Nigeria.

Chart 22: Lagos and Other Nigerian Regions' Unit Labour Costs in the Manufacturing Sector



Source: Adjusted from World Bank ES (2014/15 for Nigeria

Although further analysis is required for the Nigerian case, the facts presented above are in line with those found by Gleb, Meyer and Ramachandran (2013), who compared labour costs and productivity levels in several African countries. They presented the fact that the labour price in African countries is more expensive than expected when compared to GDP per-capita levels. This trend reflects the fact that in the African context, as firms grow larger and productivity increases, the related labour costs grow more than anywhere else.

Gleb et al. (2013) highlighted the need for Nigeria to invest in the infrastructure, such as power supplies, needed to improve the business environment. In addition, their analysis shows that low levels of income do not always translate into the ability to specialise in low wage activities. Thus, they present that resource-rich developing countries similar to Nigeria would have a comparative advantage in sectors immediately related to the resource endowment and not necessarily in low-wage manufacturing activities.

Firms in Nigeria are confronted with a difficult environment. The Doing Business report (2015) places the country 170th out of 189 globally pointing to a non-conducive investment climate that may prevent investment; resulting in lower productivity. The last two World Bank investment climate assessments (2009 and 2011) identified the same three constraints to private sector activities in Nigeria. These are: a difficult access to power supply, unavailability of credit and a poor transport network. These bottlenecks increase the operating costs of firms in Nigeria. Indeed, it is estimated that 10% of sales are lost each year due to the poor business environment, including the poor power supply, delays from a poor transport infrastructure, crime and corruption. This is twice the estimated losses observed in comparative countries, such as South Africa, Brazil, Russia and Indonesia.

3.13 Conclusions

This chapter has highlighted that oil revenue inflows have had a substantial influence on Nigeria's socio-economic development but shows that these impacts are compounded by several contextual factors. These include the country's stagnating economic development, intertwined cultural and religious cleavages, as well as unstable institutions. Further, in line with the resource curse literature and the definition of a point resource, oil has been a source of social tension and conflict as populations in the Niger Delta region have felt deprived of the resource's revenues, while also having to deal with the negative impact of oil production on the environment and on local livelihoods in the region . Although the country's revenue-sharing arrangement attempts to correct this inequality, the assumption that elites capture the benefit instead of privileging productive reinvestment apply to Nigeria.

These dynamics having transpired in the country's macroeconomic trends, Nigeria has not escaped the perverse impacts of the abundance of oil revenue. Historically, the country's fiscal policies have exacerbated volatility rather than smooth it. This, coupled with inconsistent and fairly inflexible exchange-rate policies, has created an avenue for the Dutch Disease to take root in the country. These effects are illustrated by a gradual shift in the structure of the economy driven by changes in relative prices. As a result, Nigeria has seen its agriculture sector (its main non-oil tradable) shrinking, and its manufacturing sector stagnating at the expense of a growing services sector. To mitigate these impacts, in the mid-2000s, the country attempted to reduce the impact of oil revenue volatility on public expenditure by creating an oil fund. However, this has been only partially successful. This is illustrated by the large amount of money that has been wasted on low productivity capital projects and large recurrent spending driven by a large civil service (seen as a way to redistribute oil wealth), reflecting a lack of long-term planning with political pressures driven by the voracity effect and a poor institutional environment.

These dynamics at the macroeconomic levels have affected the structure of the labour market and private sector activities. Government policies have resulted in a difficult business environment, with the existence of major barriers which crowd out private sector capital investment negatively affecting productivity. As presented above, the private sector bottlenecks are related to ineffective government spending resulting in a large infrastructure deficit. As a result, total factor productivity in Nigeria in key sectors such as manufacturing fails to reflect the country's per capita income (hinting at the oil artificially boosting this income (El-Anshasy, 2017)). Further, given the tough business environment, Nigerian manufacturing firms are not big investors. Indeed, previous studies, such as Svensson (2003), found that corruption negatively impacts investment as capital intensive firms are more likely to be exposed to corruption practices than labour-intensive firms. In addition, in the context of underdeveloped financial markets, firms are likely to underinvest as investment has to be financed internally.

Another impact of the macroeconomic dynamics is the high cost of labour, which is relatively expensive compared to other countries. Furthermore, the wage level in the country does not compensate for its low labour productivity. This implies that investment in labour productivity could attract labour-intensive manufacturing sectors seeking low labour costs. Concurrently, Nigerian value added per worker is lower than in other countries. Thus, unit labour cost (labour costs as a percentage of value added) is one of the highest in Sub-Saharan Africa. In other words, productivity does not drive wages affecting their competitiveness. This points to factors other than productivity, such as DD, underlying the wage-determination process.

Moreover, adding to the distortions related to oil revenue inflows, Nigeria’s labour market presents characteristics of a developing country with a large informal sector. Most people work for themselves and informality is the norm. Indeed, only 15% of the Nigerian labour force earn a wage. Ramachandran et al. (2013) highlight the fact that entrepreneurship is a common feature of African economies; however, firms lack the necessary dynamism to drive aggregate productivity and employment. These countries are characterised by a limited number of large and effective firms, but they often benefit from protection, allowing them, in many cases, to operate as monopolies, affecting productivity distribution.

In addition, strong social and ethnic networks in Nigeria contribute to the development of fragmented markets characterised by high search and transaction costs. This fragmentation is reflected in strong regional disparity in terms of socio-economic development, including labour costs, productivity and poverty rates. The formal and informal sectors are likely to have an impact on the way a shock (with or without mitigating fiscal policy) affects the economy.

Chapter 4
Analytical evidence of the impact of Dutch Disease on the Labour Market: REER and Firms

4.1 Introduction

It is worth remembering that resource-rich-economies are unique since an appreciation will often be caused by a commodity boom, and not a secular expansion in value-added exports such as manufactured goods. An appreciation that is caused by an expansion in manufactured exports can indicate a successful and sustainable growth path, while an appreciation caused by a commodity boom can simply reflect the successful extraction of resources to feed global demand, to the detriment of more value-adding exports. This mechanism underlines the possible developmental risks associated with Dutch Disease.

The exchange rate [5] determination process is a complex mechanism, as described in section 2.3, and it is difficult to distinguish between purely macroeconomic factors and those associated with the resource curse literature (such as political economy or policy-related factors). In a resource-rich developing country context, the exchange-rate determination process is undeniably linked to the inflows of resource revenue or at least by the way they are managed, as suggested by the DD framework. Indeed, Cashin et al. (2004) and Chen and Rogoff (2003) highlight that a commodity price increase is linked with a real exchange-rate movement (i.e. appreciation). In addition, Beine et al. (2012) have found a link between exchange-rate movement and manufacturing outputs. They also found that a Canadian dollar appreciation driven by a resource boom led to significant employment reduction in the manufacturing sector, as presented in Chapter 2.

The value and stability of a country's currency can have an important impact on trade orientation and industrial outcomes, and therefore on employment. The exchange rate is a central piece in any economy, even more so in the Nigerian context; a resource-rich developing country. Nigeria is the most populous African country, battling with issues of unemployment/underemployment. The need to look at this relationship is necessitated by several factors, including: (i) the high volatility of the naira relative compared to other emerging countries driven by resource revenue

[5] The term exchange rate used throughout this chapter refers to the real exchange rate unless stated otherwise.

inflows or policies attempting to mitigate the impact, thereby reducing the ability of exporters to plan long-term with any certainty; (ii) the exchange rate as a key economic factor; (iii) the impact of resource prices on the exchange rate as predicted by the DD framework; (iv) the need to inform sector strategies given the possible effect of exchange rate movements on labour demand; and (v) the strong global evidence that points to the importance of exchange rates in influencing employment dynamics and in enhancing a country's growth potential.

There exist several economic channels presenting the possible impact of the exchange rate on employment levels. Indeed, exchange rate variations impact the relative cost of production. Changes in relative prices influence the pricing, output and employment decisions of a firm and the relative incentive to export, to produce for the domestic market, or to import. However, evidence of the links between employment, unemployment and the exchange rate are scarce, and this is even more so in the context of developing countries.

Thus, this chapter aims to test the real exchange rate movement on the level of employment predicted by DD. The underlying question is: to what extent does the RER affect the level of employment in Nigeria? This relationship has an impact on the allocation of factors of production, which alter patterns and levels of employment across industries. The focus of this analysis will be narrowed to find the direct impact of exchange rate movements (independent of their determinants) on employment levels in Nigeria, and in the manufacturing sector as a whole, through a vector correction model analysis. Further proof of the originality of this chapter resides in the presentation of micro-level evidence using firm-level data by employing a dynamic labour demand equation and sector-specific RER.

The choice of exchange rate policy depends considerably on the institutional context and policy regime. If evidence that exchange rate movements resulting from DD, or the associated measures implemented to prevent it, have an impact on the labour market is confirmed, and policymakers can consider that the transition to a new equilibrium has an impact on a number of socioeconomic outcomes that need to be mitigated, policies that have been successfully implemented in countries such as Norway can be used. These policies may include investment to promote the non-resource tradable sector, subsidies to protect the non-booming tradable sector, saving the resource inflows and investing in foreign assets, and limiting wage increases to reflect productivity growth-rates. Thus, beyond focusing on assessing the impact of Dutch Disease, this chapter provides some suggestions as to possible policy directions that may be taken to approach these impacts.

4.2 Exchange Rate and Employment

The literature suggests (as discussed below) the existence of two main channels through which employment is affected by the exchange rate: the first relates to industry-specific contexts and the second to economy-wide behaviour.

Exchange-rate movements might affect employment levels within a country. The question linking exchange-rate movement to employment level reflects the naira's degree of volatility against other developing countries' currencies (Budina et al. 2007) and the frequent change of nominal exchange rate regimes (Bakare 2011), which could affect labour allocation within and across sectors through the different channels discussed below.

4.2.1 Macroeconomic Channel

Changes in aggregate demand can impact on a country's growth potential. Under normal circumstances, a depreciation will make domestically produced goods cheaper. This will result in higher demand for a country's exports as it is a component of aggregate demand. As more exports are produced, factors of production demand will increase to meet the additional output demand. In a case where there is unemployment, output can, among other things, be increased by hiring more labour, while the opposite is true in the case of an appreciation. To have a higher employment level as a result of a depreciation, the employment that is generated by the expansion of exports needs to be greater than the amount that is lost from contracting import-substituting industries, as long as the Marshall-Lerner condition holds, which seems to be the case in Nigeria (Adedokun, 2016; Igue et al., 2014). The underlying assumption behind the aggregate demand channel is that the depreciation will have an expansionary impact. Thus, the underlying question is whether a depreciation of a currency automatically implies a rise in employment levels and whether this change is transitory or permanent (Ngandu and Gebreselasie, 2006). Across the whole economy context, the impact of exchange rate changes is important since a depreciation can introduce inflationary dynamics, such as through increases in fuel and imported inputs, which can dampen the level of domestic economic activity, depending on the Marshall-Lerner condition.

A competitive exchange-rate policy coupled with an outward-looking set of industrial policies can lead to a labour absorbing growth process. Most high-growth countries, especially the East Asian economies, grew faster than countries with flexible exchange rates largely because of their system of managed currencies (see Ngandu, 2005; Ito and Krueger ,1999). Further, according to Ito and Krueger (1999), the exchange rate is a key macroeconomic variable linking domestic markets to the global economy. Thus, the appropriate exchange policy can contribute to developing countries' economic growth. Indeed, exchange rate policies in several East Asian countries were designed to promote exports. The result of this was rapid economic growth.

Thus, an effective exchange rate policy can lead to job creation, manifesting itself at the macro level through a boost in export and aggregate demand. At the micro-level, this will manifest itself through the channels outlined below.

4.2.2 Microeconomic Channels

(a) *External Orientation Channels:* As presented by Campa and Goldberg (1997, 2001), the exchange rate affects industries differently depending on their external orientation. This is captured by three mechanisms through which exchange rates impact employment:

(i) Export orientation. An exchange rate depreciation, for example, will facilitate exports to foreign markets and thus positively affect labour demand for these firms. The opposite is also true, with import-competing sectors being affected negatively.

(ii) The use of foreign-made inputs. Firms relying on imports may be affected negatively by an exchange-rate appreciation, thus negatively affecting their demand for labour.

(iii) The labour demand of firms competing with foreign imports will also affect exchange-rate movement. Klein et al. (2003) found, through using a model for job flows, that the employment level's sensitivity to exchange rate movements was contingent on economic openness.

(b) *Productivity Channel:* Studies in international trade, such as Melitz (2003) and Berman et al. (2009), have highlight the role of productivity in changes in the exchange rate. For example, productivity levels will determine firms' adjustment processes in response to exchange-rate depreciations. According to Berman et al. (ibid), in response to a deprecation, most productive

firms will raise their price mark-up instead of increasing export levels, whereas the least productive firms will adopt the opposite strategy.

(c) *Factor Intensity Channel:* As suggested by Ngandu (2008), this channel relates to the relative prices of capital compared to labour costs. Thus, an appreciation will lead to lower prices (in domestic terms) of imported inputs and capital goods. As a result, firms can substitute labour with relatively cheaper imported capital goods, affecting employment levels in the non-booming tradable sector. Overall, the strength of the impact will be a factor of the labour intensity of the sector. Labour-intensive sectors are less sensitive to exchange rate fluctuations as they use relatively fewer capital inputs and are less dependent on imports relative to capital intensive sectors that use many natural resource-based inputs and import a relatively higher level of inputs. This will be the main channel that will be assessed in the empirical sections of this study as the existing literature has focused mainly on the external orientation channels discussed below.

The microeconomic channels presented above are conditional on a number of other factors. Indeed, market structures and labour regulatory forces can affect output and employment responses to exchange-rate movements. (see Federer, 1993; Pindyck et al., 1993; Aizenman et al., 1999). This is also the case of financial sector development which, as described in section 3.7, is often underdeveloped in resource-rich country contexts (Bhattacharyya and Hodler, 2014; Hattendorff, 2014), and which negatively impact growth prospects and, therefore, labour market development. Thus, the oil curse could also manifest itself through an impact on the financial market; however, in the context of Nigeria, the interest rate is mainly driven by political economy factors as it is noticeable that interest levels in Nigeria are weakly correlated to the exchange rate, the oil price and the US federal reserves' interest rate.

4.3 Evidence of the Link between Exchange Rates Movement and Employment Levels

This section highlights the empirical evidence available on the relationship between exchange rates and employment levels. It is clear that exchange rates impact employment, as illustrated by studies on the US and Latin America; however, these studies focus on a very different context to that of Nigeria.

It is recognised that the literature that has focused on the direct link between employment and exchange rates is limited (Campa and Goldberg, 2001; Kim, 2005). The early studies on this topic focused on the United States (US) and assessed the possible de-industrialisation of the US economy, with attention given to the impact of dollar appreciation on manufacturing employment in the first half of the 1980s. This strand of the literature established the fact that the US manufacturing employment level was affected by exchange rates. (Branson and Love, 1986, 1987 and 1988). Furthermore, these papers indicated that the intensity of this relationship was differentiated per sector, with durable goods and metal products being positively affected by an appreciation, while non-electrical machinery output decreased. In terms of employment, similar trends were noted. This evidence also suggests that the impact of exchange-rate movements is differentiated across the US regions.

Another strand of the literature focused on firm-specific pricing decisions and industry characteristics as these are influenced by the exchange rate. Most of these studies have assessed the price adjustments resulting from exchange-rate movements. This work has focused on business pricing, output and employment decisions in response to exchange-rate fluctuations, given their external orientation, the share of foreign inputs and the exposure to foreign goods competition. Campa and Goldberg (2001) highlighted a number of features affecting the intensity of the three external orientation transmission channels, including the labour intensity of the production process, the exposure to imports, the propensity to export and the reliance on imported inputs.

Further, Branson and Marston (1989) highlighted that pricing and output decisions of the firm in reaction to exchange rates will drive employment levels. They found that Japanese prices were sensitive to exchange-rate fluctuations, implying a change in firms' mark-ups, leaving output and employment unchanged. This type of approach is country-specific, as underlined by Burgress and Knetter (1998); in the case of the US, no evidence was found of firms adjusting prices in response to exchange-rate movements. This resulted in more volatile employment and output levels. Further, Burgress and Knetter (ibid) assessed that European employment levels were less sensitive to exchange rates when compared to the US, Japan, and Canada.

An exchange-rate shock will impact the various sectors of the economy differently, depending on their intrinsic characteristics. Thus, exchange-rate movements are likely to drive inter-sectoral job reallocations, as found by Gourinchas (1999) in France. He found that firms' profit and entry/exit decisions are affected by exchange rates, and an appreciation of 1% impacts tradable sector employment by - 0.95% with a two-year lag.

The literature has focused on high-income countries, with very little attention devoted to developing economies; however, Kim (2005) developed the argument that, given the specific characteristics of developing countries' productive sectors, the effect of real exchange-rate movement on employment levels will also differ. Kim (2005), using the case study of Korea, presents a positive relationship between employment levels and exchange-rate shocks (depreciation). This impact is greater for sectors with high openness and non-reliance on imported inputs. This study also shows that, compared to the US, employment levels in Korea were found to be more sensitive to exchange rate shocks. Similarly, Hua (2007) found in the Chinese context that a real exchange-rate appreciation impacts negatively manufacturing employment.

Further, in the Latin American context, Frenkel (2004) showed that the RER appreciation and trade opening nexus negatively affected employment levels. In Argentina and Brazil, large fiscal expansion leading to increased aggregate demand were not used to offset the impact on employment. Ros (2004) showed that large unemployment levels in Latin America were driven by large resources exports and real exchange-rate appreciation. Similarly, Damill et al. (2002), in the case of Argentina, presented how changes in employment levels were driven by currency movements. However, after the exchange-rate policy was stabilised, the level of employment was more responsive to the output levels.

Finally, real exchange-rate impacts on the Nigerian labour market were analysed at the sectoral level by Folawewo et al. (2012), who found that between 1970 and 2010 the labour market adjusted to exchange-rate movements using the export orientation and import penetration channels, as suggested by Campa and Goldberg (2001). Folawewo et al.'s (2012) analysis was based on a vector autoregression (VAR) model and it found that, compared to the agricultural and service sectors, the manufacturing sector is more sensitive to exchange-rate appreciation. Similarly, Adedokun (2012) used an autoregressive conditional heteroskedastic (GARCH) model and examined the effect of real exchange-rate variations on employment levels in the Nigerian manufacturing sector via export orientation (which was found to be significant) and the import penetration channel (found to be insignificant). Apart from these papers, empirical evidence assessing the relationship between RER and employment is scarce, and evidence at the aggregate and firm-level using industry-specific exchange rates does not exist.

4.4 Empirical Approach

Based on the above, the relationship between the real exchange rate and employment levels in Nigeria will be explored. This will be achieved by analysing macro-economic data to determine the existence of a long-run relationship at the aggregate level and for the manufacturing sector, as well as examining short-running dynamics by analysing firm-level data.

Unlike the analysis completed by Folawewo et al. (2012), which presents evidence of the impact of exchange rates at the sectoral levels (i.e. services, manufacturing and agriculture), it has been found that in the agricultural sector, labour demand is linked to the sector output and oil price, as well as the interest rate. Against expectations, output and labour demand in the agriculture sector are inversely related. These results indicate that exchange rate movement has a greater negative impact on the manufacturing sector labour demand than on the agricultural sector labour demand. Additionally, manufacturing sector labour demand is positively related to the sector's output, the oil price and the interest rate. In contrast with these two sectors, the labour demand in the service sector is positively impacted by the exchange rate through the export channel and negatively through the input channel. A currency depreciation will reduce the labour demand in the service sector through the export orientation channel. As the naira depreciates, domestic services get relatively cheaper, thus demand increases leading to increased labour demand. In the case of an appreciation, importing services becomes cheaper., thus local demand decreases so does the demand for labour.

Building on that analysis, the focus will move on to assessing a different channel, the one most relevant for the manufacturing sector as this sector is more likely to be impacted by the exchange movement leading to a possible substitution of capital for labour. As the analysis focusses on the sectoral level and assesses the impact of the exchange rate through the export and import channels, both macro and firm-level aspects of the relationship of interest through a different channel will be considered.

Thus, the main focus is to assess another channel using the underlying model drawn by Frenkel and Ros (2006), employing a different empirical approach. Frenkel and Ros run a regression using unemployment, GDP, lagged REER and a time trend to capture the RER impact on the unemployment level. This study does not seem to pay attention to the possible issues that may arise in using macroeconomic data, such as stationarity issues and cointegration. Thus, for the first part of the empirical analysis in this paper, the long-run relationship between the exchange rate and employment in Nigeria will be established; the above framework will be used but attention will be paid to the issue of stationarity that may arise from the use of time-series data.

In the second part my analysis, the conclusions drawn from the macroeconomic analysis at the microeconomic level will be evaluated by an examination of the firm-level data. Making use of microeconomic data presents several advantages. Indeed, aggregate manufacturing data across countries may fail to capture hidden intrinsic trends as sectors are heterogeneous and can vary greatly. Microeconomic data can also help reduce the scale of measurement errors, thus addressing data-quality issues affecting macro-level analysis.

Overall, this study is relevant as the above empirical evidence has confirmed that the literature is inconclusive on this issue. These relationships may not have received the required attention, given their possible importance, in explaining labour-market performance in Nigeria. This study is an attempt at filling this noticeable gap in the literature; after presenting the macroeconomic aspect of the relationship between exchange rates and employment, a microeconomic picture of this adjustment using firm-level data and industry-specific exchange rates will be presented. Although a number of studies have been completed at an aggregate level (i.e. macro and sectoral level) based on different data and methodologies, this study will be the first to present evidence at the firm level using panel data and trade-weighted industry-specific exchange rates.

4.5 Macroeconomic Evidence in Nigeria

This section uses macroeconomic variables to investigate the possible long-run relationship between the level of employment (at the national and manufacturing sector level) and the exchange rate in Nigeria (proxied by the REER). The macroeconomic analysis is completed using Johansen's cointegration approach and rests on the analytical model developed by Frenkel and Ros (2006), which fits within the broader Dutch Disease literature that assumes the real exchange rate is at the centre of economic and structural distortions resulting from resource wealth. Standard time-series data methodologies, such as unit root tests (Augmented Dickey-Fuller [ADF] and Phillip-Perron [PP] unit root tests), are applied to yearly data covering the 1980 – 2010 period, and the variables are found to be co-integrated of order one, suggesting the existence of a long-run relationship between manufacturing employment, real exchange rates, and capital formation. Similar results are found at the aggregate level of employment.

4.5.1 Model Specification

Firstly, the underlying Frankel and Ros (2006) model of investigating the effect of real effective exchange-rates on unemployment in Latin America has been adjusted. In this analysis, it is assumed that employment in Nigeria is a function of REER and capital formation.

One of the main variables of interest is capital formation, which has been linked to oil revenue. Using the different time series of interest, the correlation coefficient between capital formation and oil revenue is 57%, while the correlation between capital formation and government spending is 71% (this was calculated but not included in the tables below). At the same time, oil and government expenditure are correlated at 63%. This implies that capital formation in Nigeria is linked to oil revenue through government spending.

This variable is particularly relevant as the intensity channel – i.e. the substitution between labour and capital in the case of each rate movement – was tested. This fits into the broader discussion of the nature of capital formation. Rowthron (1999) and Kapadia (2003) have studied the relationship between capital and labour to assess if these factors are substitutes or complements. If capital and labour are substitutes, more capital will negatively affect labour productivity, thus lowering labour demand. Conversely, if they are complements, more capital would result in higher labour productivity and result in higher demand.

4.5.2 Data

To study the relationship between employment variables such as total employment and employment in the manufacturing sector and the REER relevant variable, capital formation is added to capture other mechanisms that influence the employment decision. This is an extension of the empirical model developed by Frankel and Ros (2006) but it takes account of possible endogeneity between their underlying variables, such as GDP and unemployment.

In addition, for comparability purposes between micro and macro evidence, the REER – a measure of competitiveness – will be one of the key variables in this empirical analysis. An REER index, as the product of nominal effective exchange-rates (defined by the World Bank as the weighted average of the naira exchange rates against the currencies of Nigeria's main foreign trade partners) and the ratio of the consumer price index to the weighted-average consumer price index of trade partners[6], was computed. According to this definition, the REER is a useful way to assess the reallocation of production between, for example, the tradable and the non-tradable sectors.

The accumulation of capital, as defined by the World Bank, implies enhancing productivity and growth rates by adding to the existing stock of capital goods, notably through investing in the industrialisation process. The capital formation variable captures all the assets added to the economy which could lead to further investment, generates savings and/or creates wealth for future generations.

Thus, a Vector Error Correction Model (VECM) was estimated using the variables similar to Frankel and Ros (2006) in logarithm form, including employment in the manufacturing sector (millions of persons); capital formation (in constant local currency (millions)) and the real effective exchange rate index (2010 prices were used as the benchmark). Regarding the assessment of the impact at the national level, total employment (millions of persons), capital formation and REER were used. Most variables were obtained from the World Bank database with the exception of the aggregate and manufacturing employment variables, which were obtained from the Groningen Growth and Development Centre (GGDC) database. The time-series data that are applied in this chapter are yearly data collected between 1980 and 2010.

4.5.3 Methodology

This chapter investigates the long-run linkages between REER, capital formation and employment in the manufacturing sector and at the aggregate level, and the dynamic adjustment of the first difference of variables, and specifically analyses the impact of REER and capital formation at the level of employment from 1980 to 2010. To conduct this analysis, the following time-series econometric methods were applied.

The ADF test was conducted first to assess the stationarity of the data, a condition that will determine the subsequent approach. After testing for the stationarity of each variable, the two-step Engle-Granger residual-based cointegration test and the Johansen trace and maximum eigenvalue approaches were used, based on a VAR model, to measure whether the variables in

[6] Other definitions are possible – e.g. price of non-tradables to tradables. Due to data limitation, I used the definition more related to international competitiveness

the system were co-integrated. If so, the number of cointegrating vectors in the system can then be identified. In the event of cointegration among the different variables, it implies that even variables displaying non-stationarity properties have a long-run equilibrium or, to put it differently, they are a set of variables that never drift apart in the long term.

To characterise this relationship, i.e. the impact of REER and capital formation on employment levels, the Johansen maximum likelihood method was used to estimate the co-integrating vectors. While the cointegration test measures the long-run dynamic linkages among different variables, the VECM can use the first difference of variables to assess the model's dynamic adjustments.

4.5.3.1 Augmented Dickey-Fuller Unit Root Test

Since most time-series econometric methodology are designed based on the underlying assumption of stationarity, thus the prerequisite step for the analysis is to assess the properties of the different series. A series is stationary if it exhibits a constant mean, constant variance and constant auto-covariance for each given lag. Several tests have been defined to assess time-series stationary properties, e.g. the ADF test and PP test, among others.

In its most complex form, assuming a constant and a deterministic time trend, the ADF assumes the following system:

$$\Delta y_t = \beta_0 + \beta_1 t + \alpha^* y_{t-1} + \sum_{i=1}^{p-1} \alpha_i \, y_{t-1} + u_t$$

where y_t represents the variable value at time t ; Δy_t is the first difference expression of that variable; β_0 is a constant term; t is a linear trend and u_t is the error term. The test rests on examining the coefficient α^*. Thus, the series presents a unit root: under the null hypothesis $\alpha^* = 0$, and under the alternative hypothesis, $\alpha^* < 0$, the series is stationary.

To validate this presence of a unit root, the following T statistic is computed $\tau = \frac{\alpha^*}{\sqrt{var(\alpha^*)}}$ and then, as suggested by the literature, compared to the corresponding critical value. The series is said to contain a unit root (i.e. an integrated series of order one) if the null hypothesis is rejected; otherwise, it is stationary (i.e. an integrated series of order zero).

The ADF test exists in two other forms, where β_0 and β_1 are equal to 0 (the unit root test) or where $\beta_1 = 0$ (the unit root test with a constant). To decide which specification to use, standard practice suggests using the extended version. However, including irrelevant parameters will weaken the test's ability to reject the null hypothesis. Verbeek (2004) proposed a graphical inspection to support the selection of the appropriate test. If the plot of a series indicates a clear upward or downward trend, it is most appropriate to run the test with a time-trend term.

Another possible issue is the optimal lag-length selection of the dependent variable. One approach is based on the lowest value of information criteria, such as the Akaike Information Criterion (AIC), and the Schwartz Bayesian Criterion (SBIC). It is also helpful to use the SBIC criterion in cases of conflicting results as it selects the correct model with fewer lag-lengths than that of AIC.

4.5.3.2 Vector Autoregressive Model

The VAR model was developed by Sims (1980) as an extension of the univariate autoregressive model in order to capture the dynamic behaviour of an economic time series in a multivariate model. In its simplest form, the VAR model contains two variables $[y_{1t}, y_{2t}]$. The current value is dependent on the variable's lagged values and some error terms, expressed as follows:

$$\begin{pmatrix} y_{1t} \\ y_{2t} \end{pmatrix} = \begin{pmatrix} \beta_{10} \\ \beta_{20} \end{pmatrix} + \begin{pmatrix} \beta_{11} & \delta_{11} \\ \delta_{21} & \beta_{21} \end{pmatrix} \begin{pmatrix} y_{1t-1} \\ y_{2t-1} \end{pmatrix} + \begin{pmatrix} u_{1t} \\ u_{2t} \end{pmatrix}$$

where u_{1t} is a white noise term with $E(u_{1t}) = 0$ and $E(u_{1t}, u_{2t}) = 0$. This system indicates that the current values are dependent on different combinations of lag variables and error terms. This also applies to a system with more than two variables.

In order to select the optimal lag-length of the VAR model, the likelihood ratio test was used and supported by the AIC and SBIC. As suggested by the literature, the selection of the optimal lag-length was based on maximising LR, or minimising the information criteria. Nevertheless, Liew (2004) indicates that the information criteria method is more powerful than LR and, among the different information criteria methods, the AIC performs better.

4.5.3.3 Cointegration Test

A regression involving variables presenting non-stationary characteristics may result in a spurious regression affecting inference analysis. However, if a linear combination of non-stationary time-series variables exists, the series are cointegrated, implying the existence of a long-run value towards which variables converge. This allows one to circumvent the spuriousness-bias of possible interpretation. The literature has put forward the two-step Engle-Granger residual-based test and the Johansen approach to assess the existence of the cointegration relationship.

A) Granger residual Test for Cointegration

The Engle and Granger (1987) test considers the model of the form:

$$y_t = \beta_0 X_t + u_t$$

where y_t and X_t are non-stationary of order 1 (i.e. I(1)); running a simple OLS regression, the obtained residuals are $\hat{u}_t$ and tested for the presence of the unit root

$$\Delta u_t = \alpha^* u_{t-1} + \sum_{i=1}^{p-1} \alpha_i \, u_{t-1} + v_t$$

If the null hypothesis, suggesting the existence of a unit root in the residuals, is rejected, the system suggests the presence of a stationary linear combination of the non-stationary variables, indicating that the variables are cointegrated and the residuals are stationary.

In the case of a multivariate model, it is possible to have several cointegrating relationships. In such a setting, the Engle Granger approach presents some limitations which were addressed by Johansen (1988), who developed a multivariate cointegration technique.

B) The VAR-based Johansen approach

The Johansen approach is more generally applicable as it allows for the existence of more than one cointegrating relationship.

The tests and estimations are carried using a restricted VAR model. In the case of a model with nonstationary variables and integrated to order one-I(1) variables (n ≥ 2) and assumed to be cointegrated, a vector autoregressive model with k lags, including this series, can be presented as follows:

$$Y_t = \beta_1 Y_{t-1} + \beta_2 Y_{t-2} + \cdots + \beta_k Y_{t-k} + u_t$$

where Y_t is an N ×1 column vector including the I(1) dependent variables and u_t is the innovation vector N ×1.

The underlying assumption for the use of a VAR model is that all variables exhibit stationarity properties. Thus, to perform the Johansen test, the VAR model presented above is re-written as VECM as it allows a nonstationary time series to be dealt with. The VECM can be written as follows:

$$\Delta Y_t = \Pi Y_{t-k} + \Gamma_1 \Delta Y_{t-1} + \Gamma_2 \Delta Y_{t-2} \ldots + \Gamma_{k-1} \Delta Y_{t-k-1} + u_t$$

Where $\Pi = \left(\sum_{i=1}^{j} \beta_i\right) - I_n$ and $\Gamma_i = \left(\sum_{i=1}^{j} \beta_i\right) - I_n$

The matrix Π is the matrix determining the number of cointegrating vectors, assumed to be r. The Johansen approach is focused on examining the long-run cointegrating matrix Π. This matrix is assumed to be the product of α (N×R) and β (N×R) such that $\Pi = \alpha\, \beta'$

In the case of the existence of a long equilibrium, the expression above will be reduced to $\Pi Y_{t-k} = 0$ as the different ΔY_{t-k} will be equal to zero, and the expected value of the error term u_t is zero. Thus, the cointegration test entails assessing the number of eigenvalues λ_i different from zero, which will determine the rank of the matrix Π. In the case of cointegration, the rank of Π will be different from zero. Johansen and Juselius (1990) proposed the following expression for the trace test and the maximum eigenvalue t-statistics:

$$\lambda_{trace}(r) = -T \sum_{i=r+1}^{n} \ln\,(1 - \hat{\lambda}_r)$$

$$\text{and, } \lambda_{max}(r, r+1) = -T \ln\,(1 - \hat{\lambda}_{r+1})$$

where T is the sample size, λ represents the eigenvalues, while r refers to the number of cointegrating vectors. Under the Johansen test, the null hypothesis is presented as the system having at the most r cointegrating vectors, while the alternative hypothesis of more than r cointegrating vectors is tested by trace statistics.

A common issue faced when using the Johansen approach is related to the selection of the deterministic elements of the model, such as including a constant or a time trend in levels of data or cointegration equations. This aspect matters as it affects the cointegration tests and the distribution of the test statistics. Other than the graphic examination of the data, as recommended by Johansen (1992) and Irandoust and Ericsson (2004), the Pantula Principle is applied to find the appropriate deterministic factors for the different models.

4.5.3.4 Vector Error Correction Model

The cointegration analysis ensuing a VECM allows one to assess both the long-run linkages between the level series of variables and also the dynamic adjustments between the first differences of the variables. This can be explained as follows:

$$\varepsilon_t = y_t - \beta x_t$$

where β is the cointegrating coefficient, and ε_t is the error term from the regression of y_t on x_t . Then the Error Correction Model (ECM) is simply defined as:

$$\Delta y_t = \alpha\varepsilon_{t-1} + \gamma\Delta x_t + u_t$$

where u_t is i.i.d. and Δy_t can be explained by $\varepsilon_{t-1}$and Δx_t. ε_{t-1} is a disequilibrium error term which has occurred in the previous period. In the presence of cointegration, the error correction term ε_{t-1} indicates the speed at which the variable adjusts towards the long-run equilibrium value.

In this chapter, there are three variables: the log real effective exchange rate (REER), the log employment levels (Employ) and the log capital formation (Capfor) as endogenous variables. The ECM can be expressed as follows:

$$\Delta REER_t = \alpha_1 ECT_{t-1} + \alpha_2 \Delta Employ_t + \alpha_3 \Delta Capfor_t + u_{1t}$$

$$\Delta Employ_t = \beta_1 ECT_{t-1} + \beta_2 \Delta REER_t + \beta_3 \Delta Capfor_t + u_{2t}$$

$$\Delta Capfor_t = \gamma_1 ECT_{t-1} + \gamma_2 \Delta REER_t + \gamma_3 \Delta Capfor_t + u_{3t}$$

where ECT_{t-1} is the lagged error-correction term capturing departure from the long-run cointegrating relations between these three variables. In sum, the VECM is a VAR presented in first difference form and including a vector of cointegrating residuals.

4.5.4 Empirical Implementation

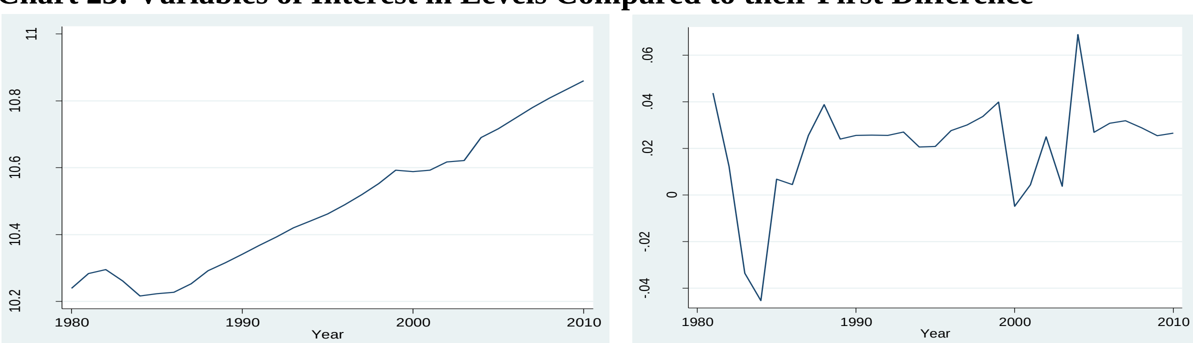
In sum, a Johansen cointegration test can be performed when the different time series are integrated of order I(1). The integration order confirms the possible existence of a long-run relationship between the different time series. To test for cointegration, the trace statistics and maximum eigenvalue are used to assess the number of co-integrating equations. Further, a VECM is applied to confirm and qualify the long-run and short-run causality between the variables. Once the existence of the long-run relationship is confirmed, an unrestricted VAR is used to assess the short-run relationships.

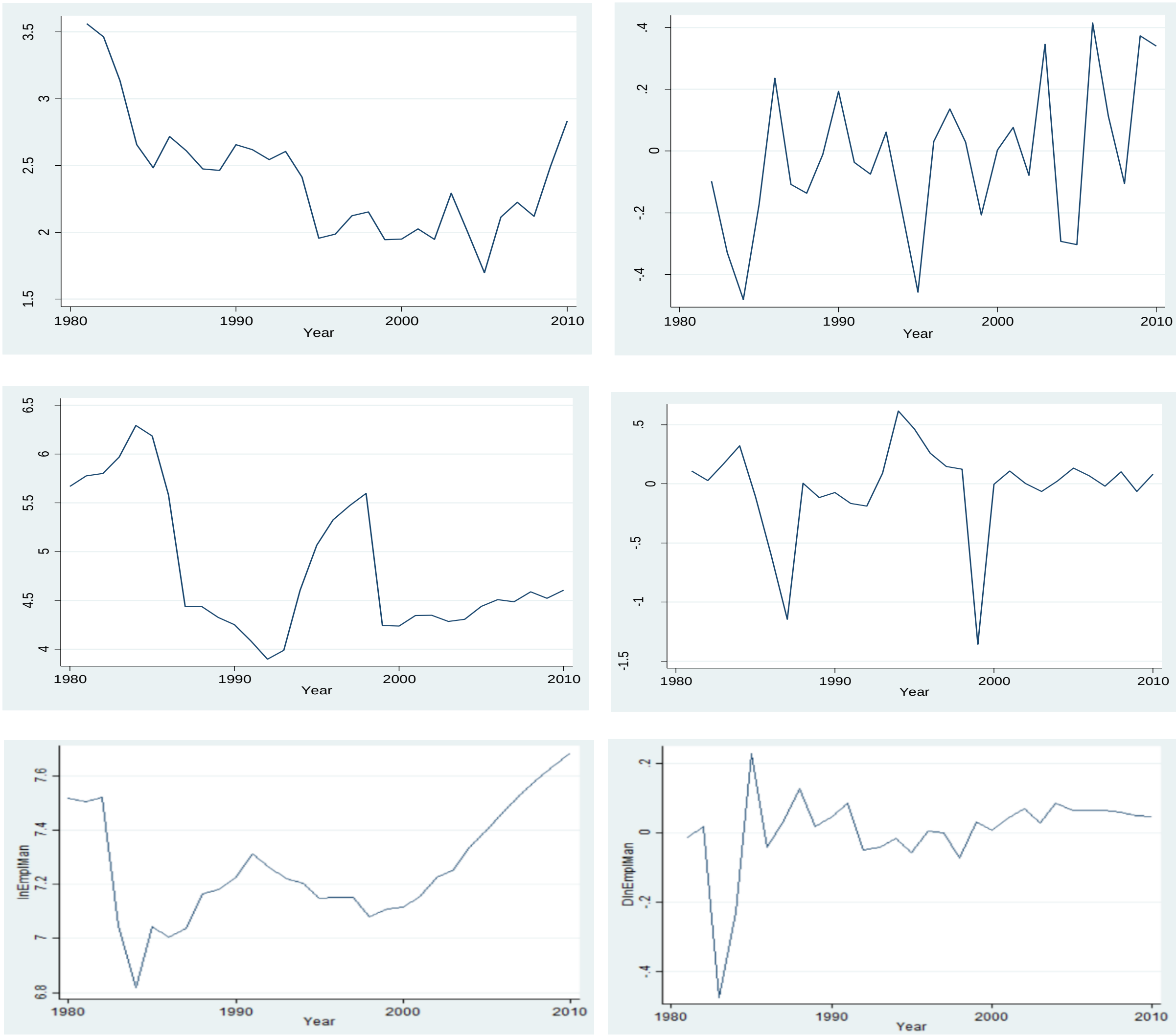
4.5.4.1 Unit Root Test

Firstly, the stationarity characteristics of the different time series are assessed. This is key to preventing inference based on spurious results that could result from not internalising the nonstationary properties of many macroeconomic variables. In the presence of nonstationary variables, they are differentiated to determine their order. Stationarity is tested through the ADF and PP tests.

As the graphic inspections of the series indicates that the data does not move around a constant and a trend, they are assumed to be nonstationary in mean (Chart 23). To make the data stationary in mean, the series are transformed using the differencing process. The graphics below indicate that the series of interest are not stationary in level but display stationary properties in their first difference.

Chart 23: Variables of Interest in Levels Compared to their First Difference





Source: Author's computation using Stata

Test for Stationarity

For the purposes of this research, the ADF, and the PP tests are implemented in Stata to assess if the different time series have a unit root and to determine the integration order of the different variables. The PP test is an extension of the ADF, as the Perron's test statistics are similar to the ADF statistics; however, it uses a covariance matrix estimator, thus solving heteroskedasticity and autocorrelation issues (Newey–West, 1987). Comparing the ADF and PP test statistics with the critical values, the conclusion is reached that the different variables have unit roots (Table 4 and Table 5); however, the first difference of all series are stationary, at least to a 10% significance level. Thus, the different series of interest are integrated at level one – I(1), while their first differences are all stationary I(0). The tables below show the results of the unit-root tests applied in this study.

Table 4: Augmented Dickey-Fuller Test on all Variables

Variable	Constant	Constant and Trend	None	Variable	Constant	Constant and Trend	None
LnEmployMa	-1.152	-2.179	0.227	DLnEmployMa	-4.302	-4.766	-4.37
LnEmploy	1.569	-1.940	5.321	DlnEmploy	-3.536	-4.212	-2.481
LnREER	-1.751	-1.741	-0.737	DLnREER	-4.029	-4.007	-4.068
LnCap	-2.744	-1.313	-1.02	DLnCap	-4.221	-5.021	-4.288

Source: Authors' computation

Table 5: Phillips-Peron Test on all Variables

Variable	Constant	Constant and Trend	None	Variable	Constant	Constant and Trend	None
LnEmployMa	-1.512	-2.138	0.195	DLnEmployMa	-4.302	-4.766	-4.37
LnEmploy	1.569	-1.940	5.321	DlnEmploy	-3.536	-4.212	-2.481
LnREER	-1.939	-2.056	-0.706	DLnREER	-4.029	-4.007	-4.068
LnCap	-2.767	-1.005	-1.026	DLnCap	-4.221	-5.021	-4.288

Source: Authors' computation

Note: constant and trend - Critical Value at 5% = -3.580; Critical Value at 1% = -4.334; Critical Value at 10% = -3.228, constant - Critical Value at 5% = -2.986; Critical Value at 1% = -3.716; Critical Value at 10% = -2.624; none - Critical Value at 5% = -1.950; Critical Value at 1% = -2.652; Critical Value at 10% = -1.602

4.5.4.2 Cointegration Test

In the case of two or more non-stationary series, a linear combination of them is stationary if these series are cointegrated (Harris, 1995) and related in the long run.

a) Lag length

To check for cointegration between the different variables (i.e. REER, capital and employment) in their logarithmic forms, the Johansen method of cointegration is applied. Then, the lag length selection is made by using information criteria, i.e. AIC, HQIC and SBIC. Table 6 shows the different criteria informing the lag length order selection. Information criteria assess the trade-off between fit and complexity, i.e. adding more lags reduces degrees of freedom and makes the model more complex but might add to the statistical fit, so information criteria give the optimal fit between these two trade-offs. The lag length is selected by minimising the information criteria. The lag length of two is chosen using criteria based on the fact that the AIC is superior in the case of a small sample as it minimises possible underestimation and maximises the possibility of presenting the true lag length, as discussed by Liew (2004).

Table 6: Lag Selection VECM

```
Selection-order criteria
Sample:      1984 - 2010                          Number of obs      =     27
```

lag	LL	LR	df	P	FPE	AIC	HQIC	SBIC
0	-56.3266				.001025	4.46864	4.52572	4.66062
1	26.763	166.18	16	0.000	7.2e-06	-.500961	-.215538*	.458918*
2	44.2958	35.066*	16	0.004	7.1e-06*	-.6145*	-.10074	1.11328
3	56.4811	24.371	16	0.082	.000012	-.331932	.410166	2.16375

Source: Authors' Computation

An '*' indicates the optimal lag. The AIC measures the discrepancy between the given model and the true model, which, of course, we want to minimise. Amemiya (1985) provides an intuitive discussion of the arguments in Akaike (1973). For a given lag p, the LR test compares a VAR with p lags with one with p − 1 lags. As discussed in Lutkepohl ¨ (2005, 143–144), the null hypothesis is that all the coefficients on the pth lags of the endogenous variables are zero. The FPE is not an information criterion, but we select the lag length that minimises the prediction error.

b) Cointegration test

Johansen's cointegration test assesses the number of long-run equilibrium relationships between variables of interest by finding the long-run stochastic trend relating to the different series. Johansen's cointegration test results (Table 7) show the existence of at least one cointegrating relationship between the three variables of interest. This suggests that there is at least one equilibrium relationship between our variables of interest and, as Johansen (1991) shows, this means our OLS estimation of the reduced form equation is not biased and is, in fact, "super-consistent".

This conclusion is based on the trace test which implies the existence of, at most, *r* cointegration vectors, while the maximum eigenvalue test evaluates the hypothesis of r+1 cointegration vectors against the hypothesis of only *r* cointegration vectors. As indicated in the table below, the trace statistic of 52.6 is greater than 42.44, which is the critical value at the 5% level of significance. This points to the existence of one possible stable long-run relationship. The exact number of cointegrating vectors is confirmed by the maximum eigenvalue test, which leads to the rejection of the null hypothesis of zero cointegrating vectors at the 1% level of significance. The output below confirms that there is one cointegrating equation in the model.

Table 7: Johansen's test for Cointegration

Johansen tests for cointegration

Trend : rtrend   Number of obs = 28
Sample: 1983 - 2010   Lags = 2

Maximun rank	parms	LL	eigenvalue	trace statistic	5% critical value	1% critical value
0	12	13.472859		52.6106	42.44	48.45
1	18	27.183997	0.62445	25.1883*1*5	25.32	30.45
2	22	34.289793	0.39804	10.9767	12.25	16.26
3	24	39.778138	0.32431			

Maximun rank	parms	LL	eigenvalue	trace statistic	5% critical value	1% critical value
0	12	13.472859		27.4223	25.54	30.34
1	18	27.183997	0.62445	14.2116	18.96	23.65
2	22	34.289793	0.39804	10.9767	12.52	16.26
3	24	39.778138	0.32431			

Source: Author's Computation

Note: By setting the option rtrend, we assume that the trends in the levels of the data are linear but not quadratic. This specification allows the cointegrating equations to be trend stationary. To confirm this the table below shows robustness

4.5.4.3 Manufacturing Sector - Error Correction Model

The long-run relationship in Nigeria between 1980 and 2010 between employment in the manufacturing sector, aggregate capital formation and REER based on one cointegrating vector is presented in Table 8 in the same form as equation 2:

$$lnEmployMa_t = -5.4 - 0.165\, lnREER_t + 0.358\, lnCapform_t - 0.015t$$

$$(0.507) \qquad (0.139) \qquad (0.006)$$

Table 8: Long Term Relationships Between Variables of Interest

Johansen normalisation restriction imposed

Beta	coef.	std. Err.	z	P>|z|	[95% conf.	Interval]
_cel						
InEmplMan	1					
InReeR	-.1650308	.0507597	-3.25	0.001	-.264518	-.0655437
InCap	.3585678	.1391539	2.32	0.020	.0717533	.854567
_trend	-.0155019	.0062615	-2.48	0.013	-.0277743	-.0032296
_cons	-5.433004					

Source: Author's Computation

All the coefficients have at least a 5% significance level. These results confirm the theoretical predictions as real exchange-rate depreciation (a decline in the variable REER) is linked to increased employment in the manufacturing sector. Thus, my estimate is consistent with the prediction of Frankel et al.'s (2006) model. As variables were considered in logarithms, the coefficients can be read as elasticities. This implies that, in the long run, a 1% appreciation of the naira will reduce the employment level in the manufacturing sector by 0.165%. However, in the long run, for a 1% increase in the country's capital formation, employment in the manufacturing sector will increase by 0.358%. This implies that firms internalise the changes in the relative price of capital and labour, but there is no substitution between capital and labour. A depreciation will imply that capital is relatively more expensive; thus, firms will focus on a labour-intensive process, while an appreciation will have the opposite impact.

This analysis indicates two key points. First, in line with the DD framework, an appreciation of the REER (driven by oil revenues or by political economy factors linked to the resource wealth) will negatively impact employment levels in the manufacturing sector, and if this sector is considered a driver of potential growth, it could hinder the country's development efforts. The second point concerns the complementary role that capital plays in the Nigerian context in the long run. This analysis indicates that capital and employment are complementary in the sense that capital investment will support higher employment levels in line with the findings of Dikko (2016), who estimated that faster capital accumulation has the potential to reduce unemployment levels in Namibia, Nigeria, and South Africa.

VECM analysis allows us to assess long- and short-run dynamics. In the estimated system, the error correction terms capture deviation from equilibrium. In conditions of disequilibrium, the statistically significant error-correction term indicates that 87% of disequilibrium is corrected. Thus, LnEmployMan with lag 1 corrects for a significant part of the disequilibrium to bring the system back in equilibrium in the long-run (see Table 9 below).

The short-run dynamics are evaluated using the Wald test to assess the significance of the variables. The analysis indicates that in the short-run, the key variable to which the level of employment is sensitive to is the past level of employment. This hints at certain levels of stickiness in the sense that adjusting capital is possibly a medium-to-long-term effort. This explains why the REER is found to have a significant impact on the employment level in the short run, but its impact is felt in the long run. Although, these short-run dynamics indicate that REER and capital have the opposite impact on employment than the one assessed in the long run. These results provide a rationale for a further analysis of the relationship using firm-level data – see section 4.6.

Table 9: Short-Run Dynamics Between Variables of Interest

	coef.	std. Err.	z	P> lzl	[95% conf.	Interval]
D_InEmplMan						
_cel						
L1.	-.8711462	.2207556	-3.95	0.000	-1.303819	-.4384732
InEmplman						
LD.	.4631602	.199701	2.32	0.020	.0717533	.854567
InReer						
LD.	0.258878	.0510461	0.51	0.612	-.0741607	.1259364
Incap						
LD.	-.1372129	.0905809	-1.51	0.130	-.3147483	.0403224
_trend	.0099874	.0026974	3.70	0.000	.0047006	.0152743
_cons	-.1526007	.0450435	-3.39	0.001	-.2408843	-.0643171

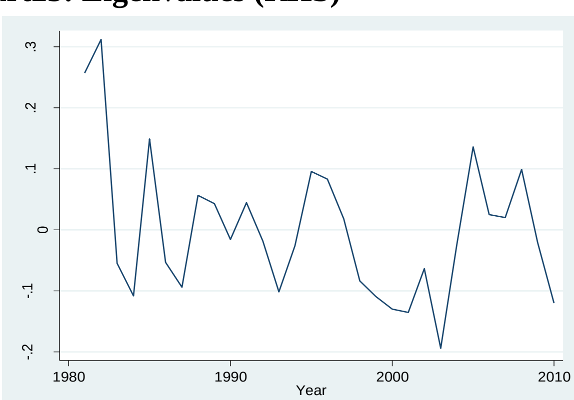
Source: Author's Computation

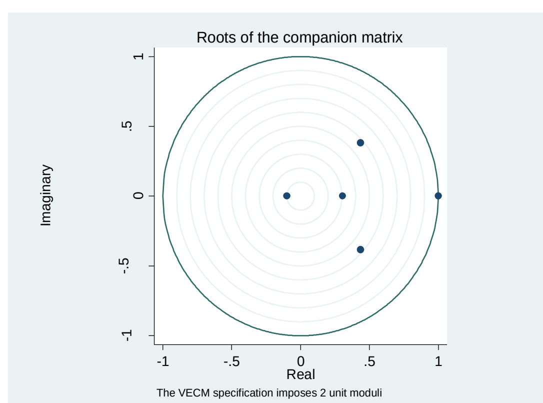
Post-estimation Analysis

Following the estimation presented above, a number of tests are implemented to assure that the model is adequate and not misspecified. As all the tests validate the model, the conclusion can be reached that the model is appropriately specified.

Under the model specification, stationarity is achieved, as illustrated by the graph below. To assess the model fit, cointegration equation errors are graphed over time (Chart 24). This is complemented with the unit circle, in line with the theory, Chart25 indicating that the stability conditions are met as all the eigenvalues are smaller or equal to one. Both tests indicate that cointegration between the variables does exist and the stability check does not indicate signs of misspecification.

Chart 24: Errors from the Cointegrating Equation (LHS)
Chart25: Eigenvalues (RHS)





Source: Author's Computation

The Lagrange-multiplier (LM) test for autocorrelation in the residuals is then run. Table 10 below contains the results of this test:

Table 10: Lagrange-multiplier test

Lag	Chi2	df	Prob>chi2
1	11.8886	9	0.21966
2	9.8110	9	0.36600

H0 : no autocorrelation at lag order

Source: Author's Computation

Relatively high p-values (Prob>chi2) show that the null hypothesis of no autocorrelation at lag order 2 may not be rejected at 5% and 10% significance levels. This indicates that the estimated coefficients are efficient as the minimum variance property holds.

Finally, the Jarque-Berra test is used to confirm if the VECM residuals are normally distributed. This will help confirm that the inferences are valid. Table 11 below presents the different tests and indicates that with the reasonable p-values the null hypothesis of normality for the key equation central to the study, D_lnEmplMan, may not be rejected at conventional significance levels (α=5%, 10%).

Table 11: Normality Tests

Jarque-Bera test

Equation	Chi2	df	Prob>chi2
D-InEmplMan	0.132	2	0.93607
D_InReer	50.042	2	0.00000
D_Incap	0.630	2	0.72990
ALL	50.804	6	0.00000

Skewness test

Equation	Skewness	Chi2	df	Prob>chi2
D-InEmplMan	-.07149	0.024	1	0.87727
D_InReer	-2.1284	21.140	1	0.00000
D_Incap	.3276	0.501	1	0.47913
ALL		21.664	3	0.00008

Kurtosis test

Equation	Kurtosis	Chi2	df	Prob>chi2
D-InEmplMan	2.6953	0.108	1	0.74210
D_InReer	7.9773	28.902	1	0.00000
D_Incap	2.6677	0.129	1	0.71963
ALL		29.140	3	0.00000

Source: Author's Computation

4.5.4.4 Total Employment – Error Correction Model

To further assess the link between real exchange rates and employment, the long-run relationship between total employment in Nigeria (Employ – series from the GGDC which includes both formal and informal employment), REER and total capital formation is established. Following the same approach described above, a system cointegrated of order 1 is obtained, with a long-run relationship (Table 12). This confirms the long-run relationship between the variables of interest and provides evidence of the relationship between the exchange rate and the aggregate level of employment.

In line with discussions presented by Frankel et al. (2006), the REER has an impact on the level of employment. In addition, capital formation impact will depend of the nature of the capital in Nigeria. The REER impact on the national level of employment is much lower than the one observed for the manufacturing sector's employment level. This hints at the fact that the manufacturing sector is more sensitive to REER movement, given international trade and competition. It also reflects the structure of the Nigerian economy, which is driven by several sectors, such as the services sector which has less foreign exposure.

The analysis so far has indicated that capital formation has a positive impact on employment levels in the Nigerian manufacturing sector. This is further confirmed using the total level of employment in the country. Similar to observations made in the manufacturing sector, capital formation is complementary to the employment level; a 1% increase in capital formation could result in a 1.76% increase in employment. This is expected given the large infrastructure deficit of the country. This impact is almost five times higher than the impact on the manufacturing sector, pointing to the issue of capital formation unlocking employment in other sectors. This also reflects the composition of the Nigerian GDP tilting towards sectors others than manufacturing.

$$lnEmploy_t = -9.955 - \underset{(0.0048)}{0.021}\, lnREER_t + \underset{(0.4555)}{1.765}\, lnCap - \underset{(0.0005)}{0.026}\phi_t$$

Table 12: Long-Run Relationship Between Total Employment and Key Variables

Johansen normalisation restriction imposed

beta	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
_cel						
InEmploy	1					
InReer	-.0205484	.0048021	-4.28	0.000	-.0299604	-.0111364
Incap	1.76471	.4555476	3.87	0.000	.8718526	2.657566
_trend	-.0265388	.0005726	-46.35	0.000	-.027661	-.0254165
_cons	-9.955104					

Source: Author's Computation

The VECM analysis, Table 13 below, indicates that most variables, apart from the lagged employment one, are found to be insignificant factors affecting employment levels, apart from the level of capital formation.

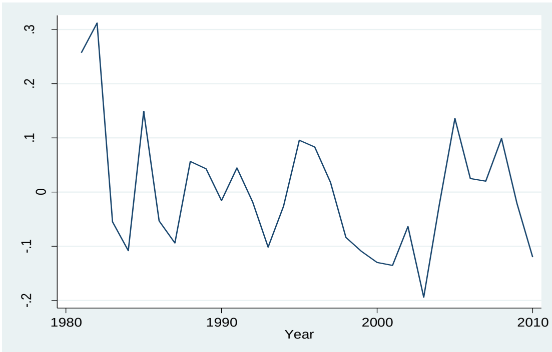
Table 13: Short-Run Dynamics Between Total Employment and Key Variables

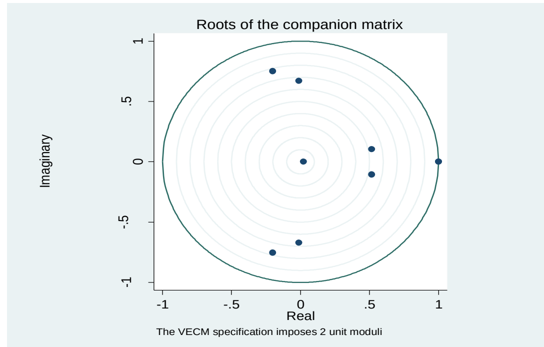
	Coef.	Std. Err.	z	P>l z l	[95% Conf.	Interval]
D_InEmploy						
_Cel						
L1.	-.0129377	.0047015	-2.75	0.006	-.0221524	-.003723
InEmploy						
LD.	.1052418	.1806194	0.58	0.560	-.2487657	.4592493
InReer						
LD.	.006925	.008163	0.85	0.396	-.0090741	.0229241
Incap						
LD.	.0388411	.0144194	2.69	0.007	0.105797	.0671026
_cons	.0223845	.0052604	4.26	0.000	.0120743	.0326948

Source: Author's Computation

Given the high statistical significance of regressors above, this vindicates the VAR-VECM methodology and the presence of both the long-run equilibrium relationship and the existence of short-run dynamics. The different post-estimation figures below (Table 14; Table 15; Chart 26; Chart27) validate the existence of a long-run relationship between employment, REER and capital.

Chart 26: Errors from the Cointegrating Equation (LHS)
Chart27: Eigenvalues (RHS)





Source: Author's Computation

Table 14: Lagrange-multiplier test

Lag	Chi2	Df	Prob>chi2
1	11.8886	9	0.21966
2	9.8110	9	0.36600
3	4.5496	9	0.87167
4	12.9758	9	0.16370

H0 : no autocorrelation at lag order

Source: Author's Computation

Table 15: Normality Tests

Kurtosis test

Equation	Kurtosis	Chi2	Df	Prob>chi2
D-InEmplMan	3.7952	0.738	1	0.39037
D_InReer	7.901	28.023	1	0.00000
D_Incap	2.7852	0.054	1	0.81654
ALL		28.815	3	0.00000

Source: Author's Computation

Jarque-Bera test

Equation	Chi2	Df	Prob>chi2
D-InEmplMan	2.306	2	0.31571
D_InReer	45.440	2	0.00000
D_Incap	0.068	2	0.96672
ALL	47.813	6	0.00000

Skewness test

Equation	Skewness	Chi2	Df	Prob>chi2
D-InEmplMan	-.57967	1.568	1	0.21049
D_InReer	-1.9319	17.417	1	0.00003
D_Incap	.05452	0.014	1	0.90624
ALL		18.999	3	0.00027

4.5.5 Conclusions

This analysis so far has investigated for the first time in the Nigerian context the labour intensity channel through which the exchange rate impacts employment. This has been achieved by assuming changes in the relative price of capital and labour and concluding that they will dampen or amplify the magnitude of exchange rate shocks on labour market outcomes. Though the empirical literature on exchange rates and employment is still growing, existing evidence shows that exchange rates exert a strong influence on employment. In order for the Nigerians government's industrial policy to achieve its goal of creating impetus for jobs, the impact of the exchange rate on traded goods needs to be considered and addressed.

The above analysis, using macroeconomic data, assesses the impact of the REER on the employment level in Nigeria, both in the manufacturing sector and at the aggregate level. In the long run, an exchange-rate appreciation as indicated by the model developed by Frenkel and Ros (2007) and suggested by the way in which the labour intensity channel decreases the employment level in the manufacturing sector, on aggregate by 0.165% and 0.02%, respectively. The difference in impacts between the manufacturing sector and the aggregate level is explained by the structure of the Nigerian economy, including the small share of the manufacturing sector in total employment. Other sectors, in particular the service and agriculture sectors (cumulatively representing over 90% of total GDP), are less sensitive to the real exchange-rate movement. Indeed, services are in general non-tradables, while the agricultural output has mainly focused on staples crops, with only 15% of farmers focusing only on cash crops (NOI polls, 2016). Thus, overall, in terms of employment, a depreciated REER will have an impact on employment but not in the needed scale; however, it will support the manufacturing sector.

Furthermore, capital formation impacts positively on the level of employment. This is in line with the level of development of the country and the large infrastructure gap it faces, illustrated by the levels of physical capital of roads, the quality of the educational system, low production and access to electricity, and poor access to public health services, all of which lag behind the regional average (Brookings 2018). This implies that capital investment leads to economies of scale and increased productivity. For example, the notorious issues of power supply in the country will impact employment, as found in other countries. Dollar et al. (2005) discovered, for instance, that fluctuating power supplies have a strong negative impact on production in Bangladesh, Pakistan, India, and China. Reinikka and Svensson (2002) submitted that in Uganda, employment, probability to export, and private investments have a negative relationship to power losses.

Finally, although not significant, the implication of the short-run dynamic analysis could indicate that an exchange-rate appreciation may lead to increased employment – against theoretical predictions. This provides the rationale for the further analysis of the adjustment dynamics of Nigerian firms to REER movements presented in the next section.

4.6 Micro-level evidence on the exchange rate impact on firms

In this section of the analysis, the short-run dynamics which appear inconclusive using a VECM are further explored. To better assess some of the short-run dynamics and the impact of REER, the determinants of employment at the firm level are investigated, taking into account the possible dynamics of such relationships, as presented in the labour literature of Eisner et al. (1963), Sargent (1978), Nickell (1986) and Hamermesh (1993) among others. The objective of this section is to measure the impact of Nigeria's real exchange rate on its manufacturing employment. This is the first analysis that looks at the impact of REER from a firm perspective using panel data from Nigeria. Another major contribution of this analysis is the construction and use of sector-specific REER, based on the assumption that price movements affecting different sectors of the economy will be driven by trade patterns which are intrinsic to those sectors.

The strand of the literature analysing the direct impact of REER movements on employment levels in the case of developing countries is growing. For example, Koren (2001), who used panel data for Hungarian exporting firms from 1992-1996, found that industry-specific REER impacted employment levels in that country. Similarly, Frenkel (2004) found that REER influenced the unemployment levels in Latin America countries such as Argentina, Brazil, Chile and Mexico. Filiztekin (2004), in the case of Turkey, also points to the impact of the REER exchange rate on employment levels in the manufacturing sector, using panel data covering the period 1981-1999.

Firm-level analysis of this type needs to take into account the fact that a movement from one equilibrium to another, in a reaction to exchange rates for example, will be affected by the type of adjustment costs they face (see Nickell 1986; Hamermesh et al. 1996; Cooper et al. 2004; Nilsen et al. 2007). Indeed, firms are confronted with adjustment costs that affect the level of labour as presented by Hamermesh (1993). Firms can react to the shocks by changing input (i.e. labour) demand. The scale of these changes is dependent on the adjustment costs they face, which may prevent them from responding optimally. This adjustment in cost could result from a number of factors, including institutional regulations, but also from economic or technological obstacles. Although the key relationship of interest here is the impact of industry-specific REER on employment, it is difficult to analyse this independently of other variables, such as capital and wages. Further, when looking at these variables and REER, it is difficult to assess causation (e.g. wages driving employment) or if employment levels reflect any underlying unobservable factors, also impacting wages and capital. Thus, without specific econometric tools taking into account the nature of these relationships, it is difficult to make an appropriate inference from the analysis.

In addition, using a panel data set with large numbers of cross-section units observed over a relatively short period of time presents some challenges. As indicated by Bond (2002), these characteristics often represent micro-level panel data that implies the need for specific estimation methods that can internalise the short time period and present consistent parameter estimates. Standard methods estimators can be inconsistent as the strict heterogeneity assumption prevents them from capturing the possible feedback loop between current and past observations, which is not a natural restriction when looking at the labour market and exchange rate. Thus, the

Generalised Method of Moments (GMM) estimators, developed by Arellano and Bond (1991, 2000) and Bond (2002) among others, are employed.

There are several reasons for preferring this method over others. The first pertains to the fact that it is in line with the dynamic VECM approach taken in the time-series analysis; it takes into account the dynamics flowing from lagged dependent and independent variables in the regression of employment. The model described above is inherently dynamic; therefore, the analysis needs to internalise this dynamic relationship between current levels of employment observed and the past REER; ignoring these dynamics, as in the case of the traditional fixed-effects estimators, could result in inconsistent estimates. One could have also estimated a fixed-effects model when working with panel data, but including lagged dependent variables can result in fixed-effect model estimates affected by a bias (see Bond, 2002 for the derivation of bias that arises).

Secondly, contrary to the OLS and fixed-effects estimates, the GMM estimator captures the dynamic underlying process, in this case employment on past REER, and thus allows for the possibility of finding valid instruments originating from the variables representing the firm's history. This will allow one to address the simultaneity issue among the variables of interest. In summary, the GMM estimator relies on internal instruments found in the dataset, then makes allowances to avoid the problem of finding relevant and valid external instruments. In this analysis, past levels of REER and employment are candidates for the role of instruments explaining current levels of employment.

Thus, for the purpose of this paper, using a data set of 200 firms covering the period 1998 to 2000, and using a dynamic estimator, the relationship between the different determinants of employment such as wages, capital and industry-specific REER and employment are investigated. Secondly, the dynamic GMM estimator is employed to assess the relationship between industry-specific REER and employment. Thirdly, the results are presented using this method.

4.6.1 The Employment Equation

The impact of the RER on employment has received limited interest compared to the number of studies related to developed economies, in particular when assessed from a macroeconomic perspective (Ay and Ayhan 2016). Studies transposing these mechanisms at the micro-level (i.e. firm-level) in developing contexts are also scarce. In attempting to do so, one has to consider the fact that a number of factors related to a firm's organisation can endogenously affect a firm's employment decisions.

Departing slightly from the model developed by Frenkel and Ros (2006), for this study, possible adjustment costs are included. In line with Lichter et al. (2012), a partial adjustment model[7] is included, which assumes that due adjustment-costs prevent firms from responding optimally and, therefore, employment levels can be sub-optimal (King and Thomas 2006) and the actual employment level L_t is affected by the optimal level of employment L_t^* as well as by past levels of employment: L_{t-1}:

$$L_t = \lambda L_t^* + (1-\lambda)L_{t-1} \qquad \text{(equation 1)}$$

To make estimations using this model, the optimal value of L_t^* needs to be taken into account. By assuming a similar production function used in 2006 by Frenkel and Ros (i.e. the Cobb-Douglas production function) and using transformed logarithms, the optimal value of employment can be expressed as:

$\ln(L_t) = \delta_1 \ln(L_{t-1}) + \delta_2 \ln(L_t^*) + v_t$ (see Nickell 1996) –(equation 2)

Without adjustment costs, firms could set employment such as $\ln(L_t^*) = \beta_0 + \beta_1 \ln(w_t) + \beta_2 \ln(k_t) + \beta_3 \ln(\sigma_t)$, where $\ln(w_t)$ is the logarithm form of the wage rate, $\ln(k_t)$ is the logarithm form of capital and $\ln(\sigma_t)$ is the logarithm form of expected demand. (see Layard and Nickell 1996). Using equation 1 and 2 presented above, the following equation is obtained:

$$\ln(L_t) = \delta_1 \ln(L_{t-1}) + \beta_0 + \beta_1 \ln(w_t) + \beta_2 \ln(k_t) + \beta_3 \ln(\sigma_t) + v_t$$

This setting captures the short-run dynamics that reflect a number of factors, including adjustment costs, a firm's expectations and a firm's decision-processes. Building on this equation are several papers, such as Layard and Nickell (1986), Nickell and Wadhwani (1989) and Blundell and Bond (2000): see also Arrelano and Bond (1991). In line with Adam and Moutos (2014), the equation is adjusted to include industry real-exchange rates. This equation will allow

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[7] Limitations of such models are discussed in Litcher et al (2012).

the labour-intensity channel to be tested by capturing aspects of the possible substitution of labour for capital, as well as the impact of REER in this process. The specification arrived at is:

$$l_{i,t} = l_{i,t-1} + \beta_1 w_{i,t} + \beta_2 w_{i,t-1} + \beta_3 k_{i,t} + \beta_4 k_{i,t-1} + \beta_5 REER_{j,t} + \beta_6 REER_{j,t-1} + d_i + \tau_t + \varepsilon_{it}$$

where i represents the firms, j reflects the relevant industry and t is the observation year. d_i represents the firm-fixed effects, capturing all the unobserved firm-related factors, REER is the sector-specific real effective exchange rate and ε_{it} is the error term. Alternatively, the equation in its reduced form becomes:

$$l_{it} = \alpha + \sum_s k_s \Delta l_{it-s} + \beta X_{it} + \gamma Z_{it} + n_i + \varepsilon_{it} \qquad s = 1, \dots, p \qquad \text{equation. (3)}$$

where l represents employment, X and Z represent REER and other characteristics of the firm and n captures the unobserved firms' effects.

A key issue with such a specification is that if variables, such as capital and wages and, to a certain extent, the sector-specific exchange rate, along with the weighted average of the trade import and export activities of a sector, are the chosen variables, then they must be based on some expectations of employment. This implies that any estimates based on equation 3 assume that currents shocks are independent of past levels of any variables of interest. Further, this assumption allows for current levels of employment to reflect current and past realisations of variables, such as wage, capital and REER. This implies that firms can choose capital levels to only affect current or future levels of employment. This has empirical implications.

4.6.2 Source of Simultaneity and Endogeneity in the Wage Equation

From an econometric perspective, simultaneity bias is present in equation (3) if $E(\varepsilon_{it}|X_{it}, Z_{it}) \neq 0$. Simultaneity will occur between employment and other variables of interest if, as suggested by economic theory, firms can select a level of employment in any period to reflect an assumed level of wages, capital and REER in that same period. While employment levels can reflect other variables, the reverse will also be true – wages, capital and trade-weighted REER will also be affected by employment. In this case, an estimate of equation (3) using OLS and the fixed-effects methods will internalise a simultaneity bias.

A possible solution to the simultaneity bias is found in a system of equations employed to estimate the impact of the different variables on employment levels. In this case, employment will depend on the relevant variables. These dependent variables in the other equations of this system, in turn, become control variables, which are allowed to be dependent on the employment level and the other variables of interest. To gain estimates from such a system will require a set of strictly exogenous instruments to be identified. This assumes the existence of at least one variable in the employment equation that is not also in the REER, wage and capital equations. In general, findings of this type, of strictly exogenous instruments, can be an arduous task, even more so considering that the number of instruments required is proportional to the number of equations included in the system.

In addition, using panel data implies the fact that there are a number of unobservable factors affecting a firm's performance and the explanatory variables of interest. These types of factors can include the managerial ability of senior staff, which is not captured by any of the variables but which can impact employment levels. This unobservable heterogeneity can cause an endogeneity bias affecting the performance of an OLS regression. In theory, this bias can be addressed by using fixed-effects or "within" estimations.

However, fixed-effects regression can be consistent and unbiased only under a number of conditions. Indeed, estimating equation (3), using a fixed-effect approach, is only consistent when the current level of each explanatory variable (capital, wages, etc.) is completely independent of the dependent variable's (i.e. employment) past levels: in other words, if $E(\varepsilon_{it}|X_{it}, Z_{it}) = 0, \forall_{s,t}$.. Other than the independence from past realisations of explanatory variables, Roodman (2009) highlights the possibility of another fixed effect bias in the context of a dynamic relationship in which a firm's past performance (y) affects the level of employment (x) but the inverse, meaning x impacting y, is not true. Within this setting, a fixed-effect regression would result in a false, but statistically significant, estimate. This form of bias is more prominent in the case of a small length of the panel data.

4.6.3 Dynamic Panel GMM Estimation

Based on the above analysis of possible bias, to estimate the relationship between the REER and employment level at the firm level, a dynamic GMM panel estimator will be used, in line with Holtz-Eakin et al. (1988) and Arellano et al. (1991), who use the dynamic structure presented by the dependent and explanatory variables. This method has been used to solve dynamic problems in analysing capital investment (Whited, 1991), economic growth convergence (Caselli et al. 1996), and labour demand (Blundell et al. 1998).

The GMM estimation approach is based on two steps. The first one entails running a dynamic model similar to equation (2) which can be written in its first-differenced form

$\Delta l_{it} = \alpha + k_p \sum_p \Delta l_{it-p} + \beta \Delta X_{it} + \gamma \Delta Z_{it} + \Delta \varepsilon_{it}, p > 0$ equation 4

Applying the first difference allows one to reduce the unobservable variables bias. Then, equation 4 is estimated using the GMM approach. This implies considering the lagged values of the set of explanatory variables as valid instruments for the current level of explanatory variables.

This means that the instruments used here to estimate equation (3) and (4) are sourced from lagged values of the variables of interest, i.e., l_{t-k}, X_{t-k}, Z_{t-k}, where $k > p$. Further, these instruments are only valid if:

i) they represent a source of variation for current variables, for example $Z_t = f(l_{t-k,} X_{t-k}, Z_{t-k})$.

ii) the lagged levels are an exogenous factor affecting changes in the current levels of employment. As a result, the lagged levels are not correlated with the error terms in the employment equation – this is known as weak rational expectations.

The second condition means that shocks to explanatory variables would not have been anticipated when the employment level was decided. As a result, p number of lags is necessary to ensure dynamic completeness of equation 2 by assuring that p lags of the employment level variable will capture the impact of past-performance on the present. Thus, by adding these p lags of employment, past performance of the firms prior to p does not impact current realisation of employment. This affirms that information beyond p is exogenous from both current and future information.

Despite its advantages, the GMM estimator presents some shortcomings. Indeed, Beck et al. (2000) highlight that the need to use models in their first-difference form can weaken the power of the existing tests as this reduces the amount of information presented by the explanatory variables. Further, Arellano and Bover (1995) indicate that the variables presented in their level forms are likely to be weak instruments. Finally, Griliches and Hausman, (1986) claim that using the first-difference forms may worsen measurement errors.

Blundell et al. (1998) developed an approach mitigating these shortcomings by allowing the GMM estimator to include equations in their level forms. Thus, by using a "stacked" system of equations, including levels and differences variables, variables in their first-differenced form can be used as instruments for equations presented in following levels. As a result, a "system" GMM estimator is obtained:

$$\begin{bmatrix} l_{it} \\ \Delta l_{it} \end{bmatrix} = \alpha + k \begin{bmatrix} l_{it-p} \\ \Delta l_{it-p} \end{bmatrix} + \beta \begin{bmatrix} X_{it} \\ \Delta X_{it} \end{bmatrix} + \gamma \begin{bmatrix} Z_{it} \\ \Delta Z_{it} \end{bmatrix} + \varepsilon_{it}$$

Despite the progress, equations in their levels form in this system will still present some unobserved heterogeneity. To cater for this issue, it is assumed that the correlation between the unobservable variables and the observed ones is constant over time. The literature posits that this assumption is reasonable with data-sets covering a relatively short time period.

Thus, the GMM system estimator provides estimates addressing a number of issues faced with dealing with panel data. These include simultaneity and the dynamic relationship between explanatory and dependent variables, as well as time-invariant unobserved heterogeneity. Further, this method implies that instruments are available within the systems as lagged-level values can serve as instruments for differenced equations: for level equations, the most appropriate instruments are lagged differences. These are only true if the assumptions of no serial correlation in the error terms are held and if orthogonality conditions are met (see Arellano and Bond 1991), which will be tested in the empirical approach. Further, another key underlying assumption of the GMM estimator is the exogeneity assumption, which assumes that historical employment levels of a given firm and other relevant characteristics are independent of current shocks. Arellano and Bond (1991) highlight how two tests have been developed to assess this key assumption.

The first one evaluates second-order serial correlation, allowing one to confirm if sufficient lags were included to fully control the dynamic relationship. If this test is conclusive, any values of the explanatory variables beyond those lags can be used as instruments, given the confirmed exogeneity to level shocks. This test implies that the residuals in the first differences (AR(1)) are expected to be correlated, while this correlation should not be found in the second differences (AR(2)).

The second test is a Hansen test of over-identification. As the dynamic panel GMM estimator is based on using lags as instruments, it implies that the system is over-identified, which can be tested through the Hansen test. Under the null hypothesis of valid instruments, the test provides a J-statistic which is distributed χ 2.

4.6.4 Data on Nigerian Manufacturing Firms

4.6.4.1 Survey

The Nigerian Manufacturing Enterprise Survey (NMES) is the panel data used for the investigation of the relationship of interest between exchange rates and firm-level employment contained within this thesis. The NMES survey was initially completed for the United Nations Industrial Development Organisation (UNIDO) and the Centre for the Study of African Economies (CSAE), based at Oxford University. At the time, the survey aimed to identify the drivers of the performance of the Nigerian manufacturing sector. It was one of the first surveys to attempt to use firm-level data, in contrast to the dominant use of macroeconomic data to study African firms.

The survey applied a stratified random sampling methodology, implying that the population firms are grouped into strata, and a random draw is completed from each stratum to select relevant firms (NMES, 2001). Thus, the frequency distribution across sectors is non-uniform. However, this methodology is useful as firms within a stratum are relatively homogeneous, but a large heterogeneity can be noted among firms in different strata. As a result, it captures the fact that the Nigerian manufacturing sector is dominated by a large number of small, homogeneous firms, while large firms represent a significant proportion of employment created by this sector. To capture this feature, large firms are over-represented compared to their proportion in the actual population (NMES report, Wave 1). A major caveat of the dataset is the fact that it is not representative of the population, which is known to include a large informal sector.

The NMES was undertaken in mid-2001 to cover the years 1998 to 2000 for the first wave; a second wave was undertaken in 2004 to cover the years 2001 to 2003. The surveys were administered to capture both current and past level-information. The surveys focused mainly on four subsectors (i.e. food processing, textiles and garments, furniture and paper processing, and metal, machinery and chemicals). Both waves of surveys covered specific parts of the country judged to be the most dynamic, such as Lagos and Ibadan in the South-West; the South East, with key cities such as Enugu, Onitsha, and Aba; and Kaduna and Kano in the north.

The timing of the survey is particularly interesting for the purpose of this research as it captures the significant devaluation of the naira that occurred in 1999. This is elaborated upon further in the section below.

The Sample

The Table 16 below shows a 35% loss in observations between the two waves, as observations dropped from 180 firms included in wave 1, covering the period 1998-1999, to 117 firms surveyed during the second wave, over the period 2001-2003. As such, this could provide an interesting angle of analysis, which could entail identifying possible factors driving firms to drop out of the survey (e.g. productivity, capital/labour ratios, fixed effects, etc.). However, this is not covered by the present analysis. Table 16 below also shows the differences in the yearly number of firms surveyed.

Table 16: Numbers of Observations Per Year and Sector

	Year						
Sub - Sector	1998	1999	2000	2001	2002	2003	Total
Paper Manufacture & Products	21	21	21	12	12	12	99
Textiles	34	34	34	13	13	13	141
Chemicals	14	14	14	11	11	11	75
Food	19	19	19	15	15	15	102
Furniture	12	12	12	11	11	11	69
Garment	40	40	40	27	27	27	201
Machines	9	9	9	9	9	9	54
Metal	25	25	25	14	14	14	117
Wood	6	6	6	5	5	5	34
Total	180	180	180	117	117	117	891

Source: The NMES

Table 17 below presents total employment per sector of interest in the different years of interest. Most sectors show a marginal increase or a decrease in total employment in 1999, while for most sectors, total employment of the firms remaining in the survey show an increase in the period 2001-2003. Similarly, Table 18 below shows the average logarithms for employment per firm. Table 19 shows the log of capital.

Table 17: Aggregate Employment Per Sector

	year					
Sub – Sector	1998	1999	2000	2001	2002	2003
Paper Manufacture & Products	839	1151	1269	511	490	480
Textiles	14140	26480	28483	15991	15236	14547
Chemicals	1155	2388	7842	7893	7919	7977
Food	6443	6399	15193	9899	10258	8391
Furniture	848	865	829	719	819	902
Garment	244	256	337	429	367	324
Machines	1724	1690	2592	3642	3712	3298
Metal	1174	1187	1155	926.1	957	1142
Wood	267	300	272	373	391	387

Source: The NMES

Table 18: Average Employment Per Sector (Log 1000s)

	year					
Sub – Sector	1998	1999	2000	2001	2002	2003
Manufacture & Products	3.49	3.59	3.60	3.24	3.23	3.17
Textiles	5.00	5.02	5.18	5.47	5.43	5.43
Chemicals	4.38	4.58	5.05	5.13	5.08	5.06
Food	4.22	3.99	4.57	4.30	4.35	4.38
Furniture	3.74	3.32	3.07	3.22	3.32	3.20
Garment	1.92	1.82	1.74	2.18	2.00	1.91
Machines	4.54	4.47	4.71	5.12	5.08	4.99
Metal	3.44	3.47	3.13	3.20	3.55	3.64
Wood	5.59	5.70	2.99	2.24	3.09	2.82

Source: The NMES

Table 19: Average Amount of Capital Per Sector (Log Millions of Naira)

	year					
Sub – Sector	1998	1999	2000	2001	2002	2003
Manufacture & Products	13.84	13.66	13.65	13.46	13.58	13.64
Textiles	13.81	13.85	13.82	13.45	13.53	13.50
Chemicals	14.02	14.30	14.16	14.23	14.34	14.30
Food	13.56	12.88	13.06	12.76	12.70	12.64
Furniture	12.70	11.93	12.18	12.54	12.47	12.56

Garment	10.95	10.94	11.07	10.42	10.68	10.70
Machines	12.12	12.07	12.60	12.93	13.15	13.23
Metal	13.76	13.30	13.18	14.37	14.27	14.16
Wood	12.75	12.60	11.99	11.29	11.49	11.74

Source: The NMES

A number of points gleaned from the dataset need to be highlighted as they have a potential impact on the analysis.

a) Real output during 1998-2003 did not increase (see Table 20). Irrespective of firm size, there was no meaningful change in real output within this sample. This suggests that in the NMES, sample firm growth is negligible. This is true for all the size categories and this result is of no consequence in terms of rise in output. It needs to be stressed that this is a result of this sample and that it is not representative of all firms in the Nigerian manufacturing sector. It is probable that a large number of firms have entered and exited the different sectors.

Table 20: Average Log Output Per Sector (Log Millions of Naira)

	year					
Sub – Sector	1998	1999	2000	2001	2002	2003
Paper Manufacture & Products	16.57	16.75	16.79	16.82	16.91	16.82
Textiles	18.42	18.52	18.75	19.31	19.40	19.36
Chemicals	18.87	19.35	19.66	20.39	20.40	20.54
Food	19.56	17.97	18.91	18.60	18.75	18.74
Furniture	16.86	16.91	16.60	16.95	17.16	17.15
Garment	14.32	14.40	14.07	14.45	14.50	14.53
Machines	18.18	18.29	18.71	18.80	18.95	18.95
Metal	17.69	17.80	17.13	18.01	17.90	18.06
Wood	16.00	16.52	16.45	15.99	17.32	17.55

Source: The NMES

b) Efficiency and productivity have not shown significant improvement (Table 21). Looking at real output per employee over the period of interest, there is no major change in productivity. Thus, the data suggests that the firms' processes did not improve over this period.

Table 21: Measure of Productivity - Average Output Per Worker (Log Millions of Naira)

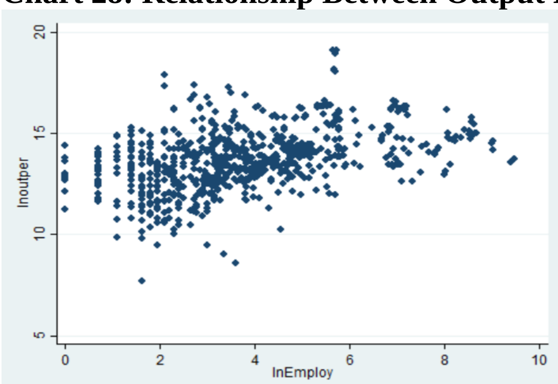
	year					
Sub – Sector	1998	1999	2000	2001	2002	2003
Paper Manufacture & Products	13.34	13.40	13.40	13.58	13.56	13.40
Textiles	13.78	13.81	13.69	13.85	13.85	13.68
Chemicals	14.63	14.85	14.78	15.26	15.20	15.22

Food	14.43	14.22	14.52	14.30	14.27	14.11
Furniture	13.13	13.63	13.71	13.72	13.72	13.70
Garment	12.60	12.86	12.47	12.26	12.37	12.37
Machines	13.94	14.06	14.17	13.68	13.75	13.72
Metal	14.48	14.53	14.17	14.39	14.23	14.28
Wood	13.81	14.68	13.63	12.61	14.11	14.48

Source: The NMES

However, sectoral labour productivity varies greatly. In terms of labour productivity, the chemicals, food and machines sectors are the most productive, followed by the metal, textiles and wood sectors, while the furniture, garment and paper sectors are the least productive. The difference between the chemicals sector and the garments sector (between the highest and lowest productivity sectors) in their logarithm form is close to 2, indicating an extremely large difference in levels. The scatter diagram below indicates that labour productivity increases monotonically with size.

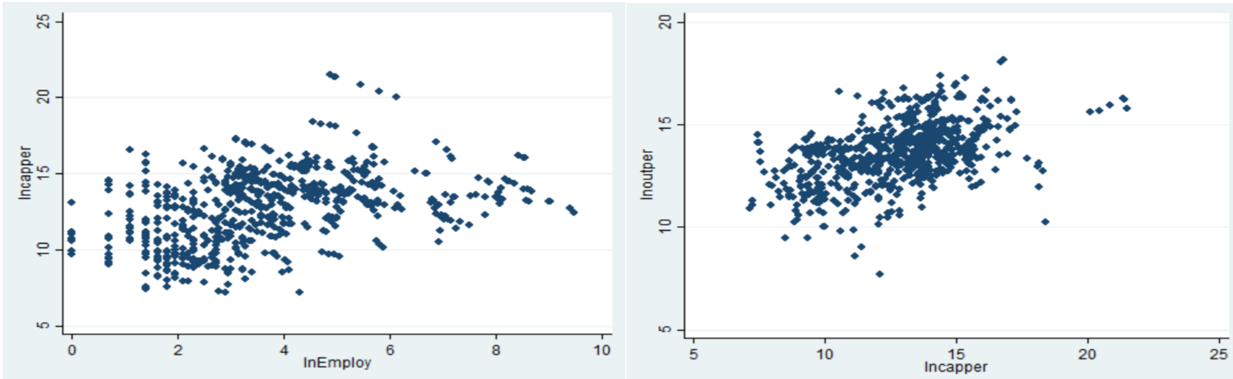
Chart 28: Relationship Between Output Per Worker and Employment



Source: Authors' computation based on the NMES

c) The capital intensity of firms is one of the underlying reasons for the observed differences in labour productivity. Capital intensity measures the relative use of capital compared to other factors, such as labour, in the production process. Both labour productivity (see Chart 28 above) and capital intensity (Chart 29; the LHS diagram below) increase monotonically with a firm's size. The scatter diagram below (Chart 29; RHS) shows the relationship between capital intensity and labour productivity.

Chart 29: Employment vs. Capital Per Worker (LHS) & Output Per Worker vs. Capital Per Worker



Source: Authors' computation based on the NMES

d) Investment and capital stock are key determinants of economic growth-rates. Moreover, the observed volatility can explain significant short-run economic fluctuations. The data highlights that investment is not a smooth process, with the majority of firms not investing in any given year. In this sample, only 48% of the firms reported non-zero investments in any given year. For the remaining 52%, the lack of investment implies that their capital stock is actually declining as they fail to replace value lost through depreciation. The survey also points to the fact that the average capacity utilisation is about 44%. As highlighted by Malik et al. (2008), capacity utilisation rates in these sectors compared to international standards are relatively low, pointing to significant excess capacity.

Based on the survey, the key variable of interest will be capital, wages and employment at the firm level in their logarithmic forms. The employment variable – lnEmploy – is the logarithm of the employment level in the firms in a given year. In line with an adjusted version of Arrendo and Bond's (1991) model, the level of employment is assumed to be determined through three factors:

(i) Capital is the firm's real total assets (in its logarithmic form). This controls for size effects that possibly impact a firm's performance, such as growth, as well as the investment and employment levels;

(ii) Wages, which represent the logarithm of the firm's real wages. Here, lagged values are used to control for the possible effect of exchange rate on employment, which will manifest itself through higher wages (Andersen and Sorensen, 1988); and

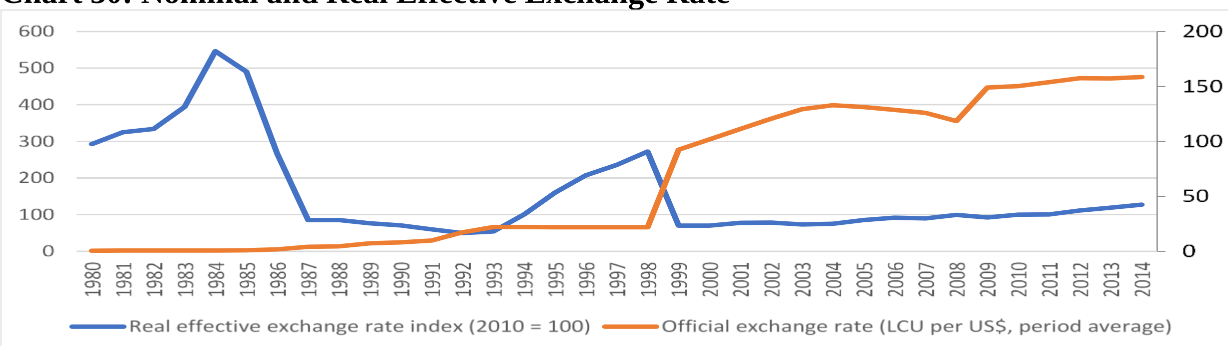
(iii) The trade-weight exchange-rate – discussed below.

4.6.4.2 Exchange Rate

4.6.4.2.1 Nigeria's Historical Exchange Rates around the Period of Interest

Chapter 3 reviewed exchange-rate policy in relation to aspects of economic development, such as oil and trade policy. Chart 30 below reminds us of the evolution of the official exchange rate against the trade-weighted REER index, i.e. the measure of a currency against a basket of other currencies that is linked to the nominal exchange rate. In this case, it shows that nominal depreciation of the naira translates into weaker (more competitive) REER.

Chart 30: Nominal and Real Effective Exchange Rate



Source: World Bank Database
Note: The REER is the nominal effective exchange rate divided by a price deflator - an increase represents an appreciation. Nominal exchange rate refers to the exchange rate determined by legally sanctioned exchange market. It is calculated as an annual average based on monthly averages (local currency units relative to the U.S. dollar).

4.6.4.2.2 Industry-Specific Real Exchange Rate Construction

In addition, it is clear that price movements will not have the same impact on different sectors of the economy as the trade patterns are likely to be different depending on the goods produced. Thus, to capture these differences across sectors and industries, a trade-weighted real exchange-rate specific to each industry of interest was constructed. This represents another key contribution of this study.

To construct these industry-specific exchange rates, in line with Golbderg (2004), the different trade partners (noted with c), both from the import and export side, were attributed a weight based on the volume of exchanges originating from a specific industry (denoted i). On an aggregate basis, the weights were allocated to each partner based on total trade (i.e. import and export activity). In other words, industry-specific real exchange-rates were computed as follows:

1. Export-weighted real exchange-rate

$$xer_t^i = \sum_c x_t^{ic} \, .rer_t^c, \qquad where\ x_t^{ic} = \frac{X_t^{ic}}{\sum_c X_t^{ic}}$$

2. Import-weighted real exchange-rate

$$mer_t^i = \sum_c m_t^{ic} \, .rer_t^c, \qquad where\ m_t^{ic} = \frac{M_t^{ic}}{\sum_c M_t^{ic}}$$

3. Trade -weighted real exchange rate

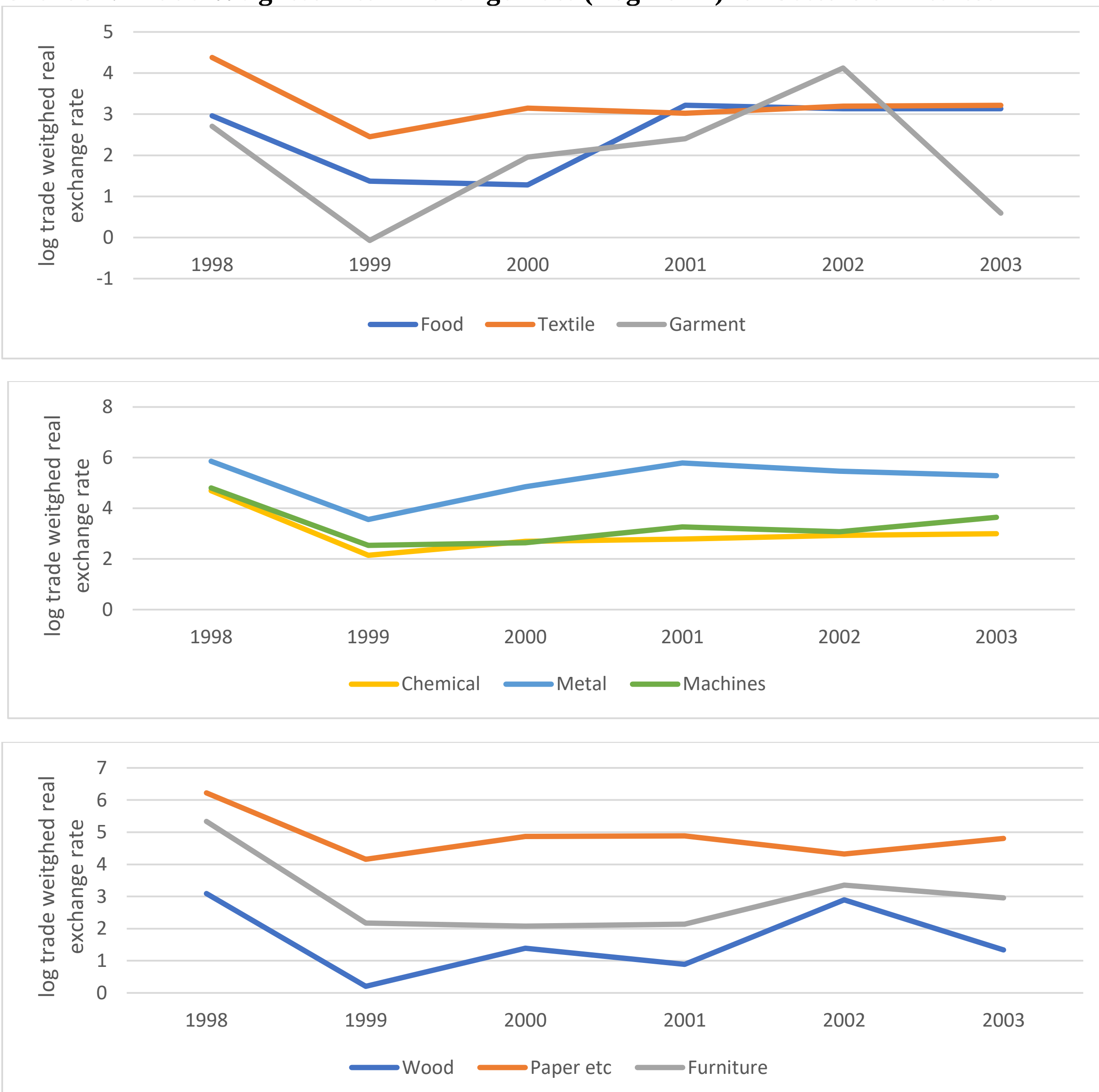
$$ter_t^i = \sum_c \left(\left(.5 \, \frac{X_t^{ic}}{\sum_c X_t^{ic}} + .5 \frac{M_t^{ic}}{\sum_c M_t^{ic}} \right)_t^{ic} \right) .rer_t^c,$$

where rer_t^c represents the RER between Nigeria and its trading partner c, which is the product of country c's nominal exchange rate and the ratio of the Nigerian consumer price index against that of country c. The index i refers to a specific industry, while t refers to a specific year. The analysis leads to the computation of an industry-specific export RER, an industry-specific import RER, and the trade-average RER. An increase in the value of any of these indexes reflect a naira real appreciation in trade-weighted terms.

4.6.4.2.3 Data

The nominal exchange rate data were taken from the World Bank database and converted to US dollars. The foreign consumers price indexes data was extracted from the same source, while the trade data was collected from the World Integrated Trade Solution (WITS) tool, which collects and compiles information on trade gathered from several international organisations, including the World Bank. Using the methodology presented above, an industry-specific exchange rate for the different sectors included in the MNES survey was obtained. Chart 31 below indicates that exchange-rate movement affects industries such as the food and chemical sector far less than the garment and wood industries. Although trends are unique to each sector, they capture large exchange rates movements, such as the 1999 naira devaluation.

Chart 31: Trade-Weighted Real Exchange Rate (Log Form) for Sectors of Interest



Source: Author's computation, trade data from the World Integrated Trade Solution (WITS) for sectors using the classification HS 1988/92; the nominal exchange rate data were taken from the World Bank database and converted to US dollars. Similarly, the foreign consumers price indexes data was sourced from the same source,

4.6.5 Empirical Evidence: The Role of the Exchange Rate on Employment

In this section, given the dynamic relationship between employment and its determinants at the micro-level, the dynamic model developed above is used. In the next sections, the relationship between employment and its determinants is estimated through a dynamic panel GMM estimator. The results of this estimation are compared to static models (i.e. OLS and fixed effects) to ascertain the bias that could result from ignoring endogeneity arising from the dynamic characteristics of the variables.

4.6.5.1.1 Ensuring Dynamic Completeness

For the purpose of this study, it is important to evaluate the number of lags needed to capture all the necessary information from a firm's past performance. A failure to capture the dynamic through which the past impact's the present could result in misspecifying equation (2) as it may suffer from an omitted variable bias. Furthermore, fully capturing the impact of past information is a necessary condition to be able to use past lags as valid instruments, as it guarantees that those past values are not related to the residuals of the present. This assumption is key as it ensures that the dynamic panel GMM estimator is constant.

As suggested by the literature in the form of Glen et al. (2001) and Gschwandtner (2005), two lags are expected to be sufficient to capture the persistence of most firms' decisions. Thus, following this recommendation, two lags are included in this analysis. To test this recommendation ensuring dynamic completeness, a regression of employment levels at time t on three lags of past employment levels is run. The results in Table 25 in the annexe confirm that two lags are sufficient as the third lag is statistically insignificant.

4.6.5.1.2 Strength of the Correlation between Past and Present Variables

A key argument driving the chosen methodological approach here is that employment levels and other variables specific to the firm are linked to the previous years' outcomes. This assumption is approached by using a number of tests. One of these tests involves running OLS regressions of current employment levels on other variables in term level form. Then, OLS regressions are also run on changes in levels on past values of variables of interest.

Table 26, in the annexe, shows that current levels and changes in REER, capital and wages are all dynamically endogenous as they appear to be linked to previous outcomes. This underlines how all the variables of interest - both explanatory and dependent - are endogenous.

In line with Wintoki et al. (2012), another test assessing strict exogeneity is included, using the only test available presented by Wooldbridge (2002). The results from Table 27 in the annexe suggest that, in line with the results presented in Table 26 in the annexe, the control variables are endogenous.

4.6.5.1.3 The Impact of the Sector-Specific REER on Levels of Employment in the Manufacturing Sector

This section examines the results from estimating the relationship between the different variables, including REER and current levels of employment. In order to present some of the issues arising from overlooking the dynamic underlying relationships, for comparison purposes, the following models are included: an OLS model, a within or fixed-effect model, a dynamic OLS model (including lags of the dependent variables) and a system GMM. These results are captured in Table 22 below.

The analysis, including two lags of employment in a dynamic model, indicates that three lagged periods or more of the different variables of interest can be used as valid instruments in the GMM estimates.

Table 22: Estimates of the Relationship between REER and Employment

Dependent variable Employment	Static Model		Dynamic Model	
	Pooled OLS	Fixed Effects	Pooled OLS	System GMM
lnWage	-0.395	-0.122	-0.186	-0.132
	(10.01)***	(3.98)***	(5.30)***	(2.96)***
lnCap	0.171	0.051	0.085	0.095
	(6.27)***	(2.18)**	(4.05)***	(4.13)***
lnSectREER	-0.044	-0.001	-0.016	-0.021
	(0.91)	(0.04)	(1.69)*	(2.21)**
L.lnEmploy			0.506	0.900
			(5.82)***	(2.81)***
L2.lnEmploy			0.041	-0.136
			(2.86)**	(0.49)
_cons	-4.065	-0.202	-1.965	-1.269
	(6.89)***	(0.25)	(2.83)***	(2.43)**
R-squared	0.63	0.29	0.90	.
AR(1) test (p-value)	(0.000)	(0.031)	(0.000)	(0.000)
AR(2) test (p-value)	(0.174)	(0.542)	(0.723)	(0.891)
Hansen test of over-identification (p-value)				(0.350)
Diff-in-Hansen tests of exogeneity				(0.274)

Notes: Estimates are based on a sample of over 200 firms over the period 1998 to 2003. Period dummies and industry-specific dummies (ISIC 2 revision 2) are included in all specifications (but are not reported) and are also part of the instrument set.

Numbers in parentheses corresponds to the t-statistics based on robust standard errors. Column 1 is based on ordinary least squares estimates, the Fixed-Effect corresponds to a regression taking into account the firm fixed effects, pooled OLS includes lag variables given the regression a dynamic dimension. System GMM denotes 1-step joint generalised method of moments estimation of the first differenced and levels equations. This latter regression used internal variables as instruments, including lagged variables of employment, wages, capital and sectorial exchange REER over the period t-3 and t-4, and difference of wages, capital and sectorial exchange REER for level equations.

The p value of 0.35 associated to the Hansen J test of over-identifying restrictions, indicates that a hypothesis of a valid instrument cannot be rejected. This table includes a difference-in- Hansen test of exogeneity. This test presented in Table 21 indicates a p-value of 0.27, confirming the hypothesis that the set of the instruments used in the levels equation of the system GMM are exogenous. The serial correlation tests are asymptotically distributed as N(0,1) under the null of no serial correlation.

Standard methods such as OLS and fixed-effects regressions present a negative relation between sector-specific exchange rates and firms' employment levels. However, this relationship appears to be insignificant and the magnitude of the coefficients vary greatly. In the simple OLS model, the coefficient is of -0.044 (t=-0.91), while in the fixed-effect regression, the coefficient is -0.001 (t =- 0.04). Nevertheless, dynamic models show that these results are significant. Even in a basic dynamic OLS estimate, the relationship between sector-specific REER and firms' employment levels is now statistically significant, the coefficient on REER is −0.108 (t = −3.07), compared to its statistical insignificance under the static OLS model.

The dynamic OLS model performs better than the other models, and the inclusion of the lagged employment variable appears to be important. Indeed, when comparing the static OLS estimation to the dynamic one, the R squared value increased from 63% to 90%. Thus, past employment levels explain a major part of a given firm's current employment levels. This is clearly noted in the VECM analysis presented above. In addition, the observed differences in the estimated coefficients on the REER across the different specifications suggest a degree of correlation between current REER levels and past employment – indicating a source of endogeneity. Despite the improvement presented by the dynamic OLS model, the estimate may still suffer from some heterogeneity bias not captured by the included lagged variables.

For this analysis, the system GMM model is the most appropriate method as it allows us to capture the dynamic relationship between employment and REER, as well as the embedded unobservable heterogeneity-characterising panel data. Thus, the GMM system indicates that the industry-specific REER is significant (-0.021, t = - 2.21) at 5%.

GMM estimates show that when fixed-effects are included in a dynamic model and estimated via the GMM system, then the coefficient of REER is now significant (-0.021, t = - 2.21) at 5%, compared to the non-statistically significant REER coefficient (−0.001, t = −0.04) obtained through the static fixed-effects estimate. This is consistent with Roodman's (2006) theory, which suggests that the OLS and fixed-effect estimators present upwards and downwards biases, respectively. Thus, the coefficient estimate using a GMM estimate lies within the theoretical lower and upper boundaries given by FE and OLS estimators.

The table above suggests that the exchange rate matters in determining the level of employment, as an increase in sector-specific REER (appreciation) reduces employment by 0.021%. This number is similar in size as the one in the long-run dynamics of the VECM analysis (i.e. 0.021). However, unlike the VECM short-run dynamics, the sign is in line with the theoretical predictions. The results point to a negative relationship between wages and employment at the firm level (-0.132, t = 2.96), as predicted by economic theory and found in a number of prior studies including Bangs (1942) and Welch (1997). In addition, capital is positively related to levels of employment with a coefficient of 0.095, highlighting that for manufacturing firms, level capital impacts positively the employment level. Finally, past levels of employment also have an impact on employment – as identified in the VECM analysis. However, the impact using microeconomic data is twice as large (i.e. 0.9 compared to 0.46 using the VECM). This possibly reflects the specificity of the firms included in the survey, such as their maturity level. Indeed, firms in the sample are growing, as illustrated by average firm output (section 4.6.5).

Table 22 presents the output of the specification tests. The AR(2) test presents a p-value of 0.89, implying that the null hypothesis of no second-order serial correlation cannot be rejected. The p value of 0.35 associated to the Hansen J test of over-identifying restrictions indicates that a hypothesis of a valid instrument cannot be rejected. This table includes the exogeneity test run on a subset of the instruments herein. As discussed in Wintoki et al. (2012), the system GMM estimator assumes that the correlation between the variables included in the model and the unobserved effect is constant over time. Eichenbaum et al. (1988) suggest testing this assumption through a difference-in- Hansen test of exogeneity. This test, presented in Table 21, indicates a p-value of 0.27, confirming the hypothesis that the set of the instruments used in the levels equation of the system GMM are exogenous.

Assessing the strength of the set of instruments

Authors such as Bond et al. (1995) and Staiger et al. (2001) have highlighted that, in the case of weakly correlated variables and instruments, results could be biased. Furthermore, the literature indicates that assessing the joint strength of the instruments is difficult; however, by adjusting the procedure developed by Staiger and Stock (1997) and Stock and Yogo (2005) to assess the strength of a set of instruments within a two-stage least squares (2SLS) regression, the system GMM instruments can be tested. Following the procedure described by Wintoki et al. (2012), Table 22 shows the results of the Cragg-Donald statistic indicating that the system GMM estimates are not affected by weak instruments.

Further discussion

This analysis has presented the impact of the sector-specific REER on employment. The underlying assumption is that the firm characteristics, such as levels of capital and wages, are determinants of one another. To further assess the mechanisms through which REER impacts employment, the impact of REER (if any) on a set of variables including capital, output, profit and investment will be discussed. In order to assess the potential role of these variables as possible mechanisms underlying the relationship between exchange rate and employment, these variables will be included in the model described in the above sections and Table 22, assessing the role of REER on employment. The results of these regressions, based on wage per worker as a dependent variable, are summarised in Table 23 below.

These results indicate that after adding in turn the three different variables (output, investment and profit) acting as potential mechanisms through which REER impacts the employment level, it can be seen that coefficients associated with output and investment are significant and positive, while those associated with REER are relatively small compared to those in Table 22. This points to the fact that the impact of the exchange rate on employment is potentially through output and investment. On the other hand, the role of profit appears to be limited as the coefficient related to REER is in line with the results of Table 22, and this coefficient is not statistically significant. This is in line with the evidence presented by the investment climate World Bank report (2014), where employment levels are expected to reflect the current level of output and the sales prospects. Indeed, the report indicates that managers tend to keep their employees waiting for economic prospects as entrepreneurs indicate that they are overstaffed in anticipation of an economic upturn; this appears to happen at the expense of profit. Further, the table below indicates the role of investment as an increase in investment is positively linked to employment. This relationship also explains the fact that coefficients associated with the capital variable is relatively lower when these additional variables are introduced.

Table 23: Relationship Between REER and Employment with additional control variables

	lnEmploy	lnEmploy	lnEmploy	lnEmploy
lnWage	-0.132	-0.129	-0.089	-0.119
	(2.96)***	(2.06)**	(2.81)***	(2.49)**
lnCap	0.095	0.023	0.064	0.042
	(4.13) ***	(2.41)**	(3.97)***	(2.76)**
lnSectREER	-0.021	-0.014	-0.017	-0.021

	(2.21)**	(4.41)***	(3.99)***	(3.11)***
L.lnEmploy	0.900	0.707	0.957	0.839
	(2.81)***	(3.94)***	(4.13)***	(3.63)***
L2.lnEmploy	-0.136	-0.075	-0.185	-0.103
	(0.49)	(0.98)	(1.33)	(0.57)
lnOut		0.041		
		(2.05)**		
lnInv			0.037	
			(1.66)*	
lnProfit				-0.007
				(0.43)
_cons	-1.269	-0.763	-1.124	-1.377
	(2.43)**	(2.51)**	(1.84)*	(3.86)***
AR(1) test (p-value)	(0.00)	(0.00)	(0.05)	(0.06)
AR(2) test (p-value)	(0.89)	(0.74)	(0.51)	(0.78)
Hansen test of over-identification (p-value)	(0.35)	(0.52)	(0.48)	(0.46)
Diff-in-Hansen tests of exogeneity (p-value)	(0.27)	(0.23)	(0.28)	(0.132)

Notes: Estimates are based on a sample of over 200 firms over the period 1998 to 2003. Period dummies and industry-specific dummies (ISIC 2 revision 2) are included in all specifications (but are not reported) and are also part of the instrument set. Numbers in parentheses corresponds to the t-statistics based on robust standard errors.

The system GMM corresponds to denotes 1-step joint generalised method of moments estimation of the first differenced and levels equations. This latter regression used internal variables as instruments, including lagged variables of employment, wages, capital and sectorial exchange the REER over the periods t-3 and t-4, to which lagged variables of output, investment and profit are added in turn (column 2, 3 and 4 respectively), and the differentiated variables of wages, capital and sectorial exchange REER, to which lagged variables of output, investment and profit are added in turn (column 2, 3 and 4 respectively), for level equations.

The p value associated with the Hansen J test of over-identifying restrictions, indicates that a hypothesis of a valid instrument cannot be rejected. This table also includes a difference-in- Hansen test of exogeneity. This test confirms the hypothesis that the set of instruments used in the levels equation of the system GMM are exogenous. The serial correlation tests are asymptotically distributed as N(0,1) under the null of no serial correlation.

To further assess these mechanisms, they are examined to see whether a firm's characteristics, such as profit, investment and output, are also determined by exchange rate movements by applying the dynamic GMM panel estimator. The following form is an estimated empirical model:

$$x_{it} = \alpha + \sum_{s} k_s x_{it-s} + \gamma Z_{it} + \eta_i + \varepsilon_{it} \qquad s = 1, \dots, p,$$

where x is a firm's characteristics, such as profit, investment and output, and $Z_{it}$is a vector of these characteristics, but including employment levels. This assumed relationships takes root in the large number of empirical studies that examine the impact of the various hypothesized determinants of firm profitability, including exchange rate, employment levels, output and capital, as presented by Nanda et al. (2018), and the level of output, as identified by Clark (2009) and Collins (2010). This is implemented using the steps presented in the above sections; the results are presented in Table 24, summarising the outputs of the GMM regressions.

In line with the DD framework, an exchange rate appreciation caused by a commodity boom results in negatively affecting the rate of return of capital in the tradable sectors; this has implications for the sector distribution of investment. Appreciation will have an impact on the future investment response of the sector since capital might be invested in other productive sectors of the economy. The inability of the manufacturing sector to attract investment in the future will hamper its capacity to compete internationally. This mechanism seems to be at work in the Nigerian manufacturing sector. Indeed, the table below indicates that profit, output and investment are all impacted by REER.

Table 24: Key Relationship Estimates (GMM)

	lnProfit	lnOut	lnInv
lnProfit		0.140	0.170
		(3.31)***	(1.73)*
lnOut	0.408		0.051
	(2.21)**		(0.09)
lnInv	-0.308	0.251	
	(2.77)**	(1.92)*	
lnCap	0.207	0.062	0.321
	(2.58)**	(1.05)	(2.21)**
lnEmploy	-0.280	0.356	0.476
	(3.40)***	(2.17)**	(3.25)***
lnSectREER	-0.062	-0.080	0.067
	(1.89)*	(2.93)***	(2.66)**
L.lnProfit	-0.006		
	(2.32)**		
L2.lnProfit	0.372		
	(0.94)		
L.lnOut		0.861	
		(2.20)**	
L2.lnOut		-0.213	
		(0.62)	
L.lnInv			0.661
			(2.41)**
L2.lnInv			-0.166
			(1.03)
AR(1) test (p-value)	(0.00)	(0.00)	(0.00)
AR(2) test (p-value)	(0.89)	(0.74)	(0.81)
Hansen test of over-identification (p-value)	(0.45)	(0.52)	(0.68)
Diff-in-Hansen tests of exogeneity (p-value)	(0.22)	(0.25)	(0.30)

* p<0.1; ** p<0.05; *** p<0.01

Source: Author's computation

Notes: Estimates are based on a sample of over 200 firms over the period 1998, to 2003. Period dummies and industry-specific dummies (ISIC 2 revision 2) are included in all specifications (but are not reported) and are also part of the instrument set. Numbers in parentheses corresponds to the t-statistics based on robust standard errors.

The system GMM corresponds to denotes 1-step joint generalised method of moments estimation of the first differenced and levels equations. These regressions used internal variables as instruments. Column 1 uses profit as a dependent variable and lagged profit, investment, capital, employment and sector REER are independent variables form which the instruments are sourced in the form of lagged values t-3 and t-4 of investment, capital, employment and sector REER. For the level equations, investment, capital, employment and sector REER excluding the dependent variable are used as instruments. Similarly, column 2, output is the dependent variable and lagged output, investment, capital, employment and sector REER are independent variables from which the instruments are sourced in the form of lagged values t-3 and t-4 of investment, capital, employment and sector REER. For the level equations, investment, capital, employment and sector REER excluding the dependent variable are used as instruments. The same is applicable to investment as a dependent variable.

The p value associated to the Hansen J test of over-identifying restrictions indicates that a hypothesis of a valid instrument cannot be rejected. This table also includes a difference-in- Hansen test of exogeneity. This test confirms the hypothesis that the set of the instruments used in the levels equation of the system GMM are exogenous. The serial correlation tests are asymptotically distributed as N(0,1) under the null of no serial correlation.

The sector-specific REER negatively impacts firms' output and profit while it is positively linked to investment. This implies that an exchange rate appreciation can affect negatively the manufacturing sector's profitability. As tradable goods such as manufacturing are often competing with international goods, their relative increase in price makes them less attractive to the external market, thus negatively affecting output. Non-exporting Firms find that their production costs are higher than in other parts of the world and thus they face tougher competition from imported goods at the sectorial level, as argued by Folawewo et al. (2012). This is in line with the DD framework as investors may find tradable goods less attractive.

In addition, Table 24 column 2 above interestingly indicates that increased employment negatively impacts profit, but it is beneficial to output. This highlights the fact that the production process is still relatively labour-intensive, as illustrated in the previous chapter (Chapter 3). Similarly, a large labour force is also linked to increased investment (column 3). The table also indicates that employment has a greater role on profit than profit has on employment. This underlines the fact that an employment decision is a medium-term decision and, in the short run, though firms' investments are impacted by profit, the employment decision appears less sensitive. This is explained by the firms mainly employing labour in the network and driving the limited labour mobility; thus, labour adjustment costs are relatively high.

Finally, investment similar to capital is positively associated with the REER and output level, while an increase in capital and employment increases investment levels. This points to the complementary role of labour and capital in the Nigerian context. In addition, and as expected, an appreciation encourages investments. This is likely to operate through the relative price of imported investment goods becoming cheaper. Overall, this points to the fact that REER contributes to the substitution of labour for capital. Indeed, REER is a positive determinant of capital levels, while this role is reversed when looking at labour.

4.6.6 Conclusions

Theoretical and empirical research at the firm level are affected by endogenous dynamic relationships between control and dependent variables. Very often, empirical research implies assessing the existence of a causal effect, of a firm's characteristic (X) on some measure of outcome such as employment level (Y); and the inference will include a number of control variables (Z). However, such an estimate may lead to bias estimates if the variables are affected by endogeneity. Further issues could arise with unobservable heterogeneity described as factors affecting both control and dependent variables. Another type of bias is the simultaneity issue arising when, for example, a firm's current decisions impact on its performance in the following periods, which in turn impacts on the firm's future decision-making. In the context of the impact of the REER on employment, the current firm's employment levels performance will influence capital and wage choices and, to some degree, sector-specific REER, and these may impact expected firm employment levels.

In this chapter, first the GMM estimator was discussed and the advantages of using such methods to assess the relationship of interest were presented. The GMM estimate is shown to be more accurate than fixed-effects estimates, which can be biased when dependent and control variables are dynamically linked. This technique is appropriate for estimation of the impact of sector-specific REER on employment levels in a panel of 200 firms operating in various manufacturing sectors over the period 1998–2003. Employment is presented as being, in part, determined by past levels of employment, and after taking this characteristic into account, the existence of a causal relationship between employment and the following control variables: REER, wage, capital, and firm performance was demonstrated.

Sector-specific movement is, to an extent, linked to capital within the sector, but more importantly, it has been shown that a 1% increase (appreciation) of sector-specific REER results in a decrease of employment of 0.021%. This is in line with the long-run dynamic obtained with the VECM analysis. This implies that firms react to labour costs being relatively more expensive in the light of an appreciation against other factors of production (which is primarily imported in the Nigerian context – see Kojo, (2014)). This indicates that the possible REER appreciation will have a negative impact on the level of employment, and this is in both the short- (GMM analysis) and long-run (VECM analysis).

Further, this analysis also indicated that capital and employment levels are complementary in the context of the Nigerian manufacturing sector, implying that an increase of capital is beneficial for the employment level. However, the micro-evidence indicated a small impact of capital on employment (coefficient of 0.1), which is almost 2/3 smaller than the coefficient obtained at the macro level. This could be explained by the fact that the sectors included in this survey (such as paper and furniture) can easily substitute labour for capital, but it is interesting to consider that this impact, at the micro-level, was noted over a relatively short period of time.

Thus, the analysis shows that, as predicted by the labour-intensity channel, exchange rates do lead in the short-run, to a possible substitution of labour with capital, as they affect, positively, capital levels and, negatively, employment. The analysis shows that REER appreciation results in lower investment and lower profit (as margins are reduced if firms compete with imported goods); however, capital increases as firms can take advantage of cheaper imported capital.

Taken in isolation, the first symptom of Dutch Disease has a negative impact on employment levels as predicted by the framework. However, this could be mitigated by the role it has on the price of capital and the fact that capital and employment are complementary in the Nigerian formal manufacturing context. Although the composition of the economy is thought to be different from the period 1998-2003, it still offers relevant lessons regarding the exchange-rate volatility experienced by the country at the end of the commodity super-cycle.

From a policy perspective, if the Nigerian government is to recognise the impact and potential benefit of the manufacturing sector on job creation and possible growth, it needs to implement the right economic policies. Revenue inflows coupled with appropriate industrial policies can contribute to economic diversification efforts. This can be illustrated by the experience of several developed countries, including Australia, the United States, and Norway. Another way to foster economic diversification is through providing tax incentives to non-resource tradable sectors. The revenue inflows following a commodity boom can support a transfer of capital by facilitating the import of advanced capital goods that cannot be made locally. This kind of investment improves economic competitiveness and generates little exchange rate appreciation.

4.7 Appendices

Appendix 1: The number of significant lags

In column 1, lags 3 and older lags are not statistically significant contrary to the first two lags, which are statistically significant. In column 2, the results of a regression only, including the older lags, are presented. In both columns, the older lags are statistically significant, indicating that these older lags contain relevant information that is captured by more recent lags.

Table 25: How Many Lags Are Significant?

The table below reports results from the following OLS model:

$$l_{it} = \alpha_1 + \sum_{p=2}^{p=4} K_p\, l_{it-p} + KZ_{it} + n_i + \varepsilon_{it}$$

l_{it} represents the employment level; Z_{it} includes sector-specific REER, capital and wages, all in their logarithm form. The relevant t-statistics based on firm-clustered standard errors are reported in parentheses. Year dummies (1998, 1999, 2000, 2001, 2002 and 2003) and industry dummies (ISIC level 2 revision 2) are included in all specifications. Numbers in parentheses correspond to t-statistics and *, **, *** are significance levels at 10%, 5% and 1%, respectively. The serial correlation tests are asymptotically distributed as N(0,1) under the null of no serial correlation.

	lnEmploy	lnEmploy
lnEmploylag1	0.487	
	(14.47)***	
lnEmploylag2	0.057	
	(1.80)*	
lnEmploylag3	-0.032	0.080
	(1.30)	(3.72)***
lnWage	-0.198	-0.406
	(9.18)***	(19.14)***
lnCap	0.087	0.147
	(6.02)***	(8.68)***
lnSectREER	-0.032	-0.108
	(0.93)	(4.41)***
_cons	-2.052	-4.127
	(6.39)***	(13.86)***
R-squared	0.89	0.83
NT	533	580
AR(1) - p-value	(0.000)	(0.000)
AR(2) - p-value	(0.317)	(0.725)

* p<0.1; ** p<0.05; *** p<0.01

Source: Author’s computation

Appendix 2: Relationship between variables of interest, and past realisations

In Panel A of Table 26, OLS regression estimates of REER and other variables of interest on lagged employment levels and firm characteristics are presented. Findings show that current levels of employment are negatively related to lagged wages and lagged sectoral exchange-rates, while employment is positively related to past capital levels. This is line with Frenkel (2004), who links unemployment to lagged REER. Further, wages are positively associated to lagged employment levels and to lagged levels of capital, while they are negatively related to the sector exchange-rate. Similarly, the actual level of capital is positively related to past employment levels and wages. It is also positively related to the past but not at a significant level. Finally, given the computation of the sector-specific trade-weighted exchange rate, the assumption that REER could be affected by the past performance of firms is possible (even more so if government policies are sensitive to firms' performance). Thus, sector-specific REER is negatively related to (but not at a significant level) past levels of wages and employment, while it is positively (at a significant level) related to lagged capital levels. Overall, the table indicates that for firms facing an appreciated REER in the past, capital is likely to be larger today, but they will experience a lower wage bill and employment level. This points in the direction of this paper's hypothesis, suggesting that REER affects the price of labour and capital encouraging a substitution effect.

Panel B of Table 26 shows OLS estimates of employment and other variables of interest and their lagged values. The results presented in this table are similar to the regressions using level variables. Again, results indicate changes in employment in response to past variables such as capital and sector-specific REER

Table 26: Relationship Between Variables of Interest, and Past Realisations

This table presents the OLS regressions of current employment (lnEmploy), wages (lnWage), capital (lnCap) and sector REER (lnSect REER) on lagged values of variables of interest. A variable name followed by "lag1" indicates the lagged value of the variable of interest, while a variable name preceded by "D." indicates the first difference value of the given variable. The results are based on a sample of over 200 Nigerian firms. Regressions include time years dummy variables for the years 1998 to 2003 and industry dummies (ISIC level 2 revision 2) from the NMES, (but which are not reported). In panel A, the dependent variables are at current levels, while in panel B, s the dependent variables are the first difference. The serial correlation tests are asymptotically distributed as N(0,1) under the null of no serial correlation.

Panel A: Dependent variable is level at time t

	lnEmploy	lnWage	lnCap	lnSectREER
lnWagelag1	-0.306		0.319	-0.033
	(10.62)***		(4.51)***	(1.21)
lnCaplag1	0.132	0.108		0.033

	(5.53)***	(2.86)***		(1.78)*
lnSectREERlag1	-0.215	-0.238	0.023	
	(3.63)***	(2.72)***	(0.20)	
lnEmploylag1		0.888	0.791	-0.031
		(12.51)***	(7.24)***	(0.71)
_cons	-2.142	10.373	7.118	3.578
	(5.31)***	(18.45)***	(6.45)***	(10.61)***
NT	553	553	553	553
AR (1) - p-value	(0.017)	(0.000)	(0.025)	(0.010)
AR(2) - p-value	(0.543)	(0.305)	(0.871)	(0.789)
R-squared	0.66	0.69	0.69	0.73

* *p*<0.1; ** *p*<0.05; *** *p*<0.01

Panel B: Dependent variable changed from t −1 to t

	DlnEmploy	DlnWage	DlnCap	DlnSectREER
lnWagelag1	-0.087		-0.030	-0.013
	(3.33)***		(0.67)	(0.32)
lnCaplag1	-0.042	-0.048		-0.081
	(1.96)**	(1.53)		(2.76)***
lnSectREERlag1	-0.166	-0.200	0.148	
	(3.09)***	(2.70)***	(1.91)*	
lnEmploylag1		-0.158	-0.032	0.097
		(2.66)***	(0.47)	(1.38)
_cons	2.531	1.796	-0.669	2.202
	(6.94)***	(3.77)***	(0.98)	(4.15)***
NT	513	513	513	513
AR (1) - p-value	(0.013)	(0.754)	(0.201)	(0.000)
AR(2) - p-value	(0.188)	(0.434)	(0.015)	(0.910)
R-squared	0.11	0.13	0.16	0.33

* *p*<0.1; ** *p*<0.05; *** *p*<0.01

Source: Author's computation

As indicated by Wintoki (2012), a test of strict exogeneity was performed. If $X_{i,t}$ is assumed to contain the model control variables, strict exogeneity is estimated through the following fixed-effects model:

$$l_{it} = \alpha + \beta X_{i,t} + \varphi W_{i,t+1} + n_i + \varepsilon_{it}$$

where $W_{i,t+1}$ represents future values of the relevant variables. The null hypothesis of strict exogeneity suggests that future realisations of control variables are independent from current values of the dependent variables i.e. φ=0.

Table 27 shows estimates with different subsets of variables, $W_{i,t+1}$. In the different specifications, the coefficient related to the future values of control variables, such as wages, capital and REER, are significantly different from zero. This suggests that these variables reflect the level of employment (i.e. they are not strictly exogenous). This is confirmed by an F-test of the joint significance, confirming the theoretical predictions and the results from the OLS regressions in Table 26 above.

Table 27: Do Firms' Variables Adjust to Past Realisations?

The table reports the fixed-effects estimates: $l_{it} = \alpha + \beta X_{i,t} + \varphi W_{i,t+1} + n_i + \varepsilon_{it}$, , t = 1998, 1999, 2000, 2001, 2002 and 2003, where Wit+1 includes future values of control variables, X – which includes wages (LnWage), capital (lnCap), sector REER (lnSectREER). l is the firm's level of employment. $\varphi = 0$ is the null hypothesis of strict exogeneity. The analysis is based on over 200 firms observed over the period 1998 to 2003. The data is from the NMES. All numbers in parentheses correspond to robust standard errors. Year dummies are included in all specifications, as well as industry dummies (ISIC level 2 revision 2) - (but are not reported). The serial correlation tests are asymptotically distributed as N(0,1) under the null of no serial correlation.

	lnEmploy	lnEmploy	lnEmploy	lnEmploy
LnWage	-0.400	-0.392	-0.393	-0.395
	(18.02)***	(16.75)***	(19.55)***	(15.73)***
LnCap	0.173	0.176	0.172	0.176
	(9.76)***	(8.74)***	(10.25)***	(8.54)***
lnSectREER	-0.049	-0.087	-0.084	-0.135
	(1.07)	(1.65)*	(1.62)	(1.83)*
LlnWage1	-0.048			-0.030
	(1.78)*			(2.11)**
LlnCap1		-0.040		-0.025
		(1.21)		(1.69)*
LlnSectREER1			0.042	0.045
			(2.35)**	(0.89)
_cons	-4.145	-3.922	-4.012	-3.887
	(10.23)***	(9.32)***	(10.52)***	(8.91)***
NT	553	553	553	553
AR (1) - p-value	(0.000)	(0.017)	(0.012)	(0.010)
AR(2) - p-value	(0.111)	(0.351)	(0.587)	(0.497)
R-squared	0.83	0.83	0.83	0.83

* p<0.1; ** p<0.05; *** p<0.01

Source: Author's computation

Appendix 3: Strength of instruments

As described by Wintoki et al. (2012), if l is employment and X includes all the regressors, the system GMM involves estimating the following:

$$\begin{bmatrix} l_{it} \\ \Delta l_{it} \end{bmatrix} = \alpha + \beta \begin{bmatrix} X_{it} \\ \Delta X_{it} \end{bmatrix} + \varepsilon_{it}$$

To assess the strength of the instruments used in this study, lagged differences as instruments in the level equations and lagged levels as instruments in the differenced equations are separately assessed. The equation in the levels indicates: $l_{it} = \alpha_l + \beta_l X_{it} + v_{it}$ Instrument ΔX_{it-2}

And the equation in differences: $\Delta l_{it} = \alpha_d + \beta_d \Delta X_{it} + v_{it}$ Instrument X_{it-3}

Table 28 shows that the F-statistics results for all the first-stage regressions are significant, which confirms the strength of the selected instruments in explaining the endogenous variables. Further, the F-statistics are larger than 10, which corresponds to the critical value proposed by Staiger et al. (2001) as a rule of thumb.

Table 28: Level Equation (Top Part) – Difference Equation (Bottom Part)

	F-Statistic	p-value	R^2
lnWage	16.17	0.00	0.3866
lnCap	18.68	0.00	0.4224
lnSectREER	24.29	0.00	0.7730
	Cragg-Donald statistic: 20.5		

	F-Statistic	p-value	R^2
lnWage	12.10	0.03	0.3313
lnCap	13.40	0.01	0.2327
lnSectREER	38.72	0.00	0.3979
	Cragg-Donald statistic: 3.48		

Source: Author's computation

Chapter 5
Oil Abundance and Inequality in Wages: A Decomposition Analysis

5.1 Introduction

In the discussion in Chapter 4 above, wages are negatively related to employment levels. This implies that in the Nigerian context an increase in wages impacts negatively on the level of employment. Thus, through the lens of the DD framework, the determinants of wages and the role potentially played by oil in determining wages will be explored. In addition, I the influence of oil in explaining wage inequality observed across the country will be assessed. This could be significant in quantifying - for the first time in the Nigerian context - the impact of oil on wages, as well as in terms of policy direction regarding the country's competitiveness (i.e. does the country's oil-revenue sharing formula affect its ability to compete internationally?).

Working from the assumption that the possible negative impact of resources is greater for point resources than diffuse resources (Engerman and Sokoloff, 2002; Isham, et al. 2003) and given their localised nature, the following analysis will focus on subnational units such as states which have recently been the focus of a number of studies replicating growth regressions often presented in cross-country analysis but using subnational data (see literature review in Chapter 2). Overall, these studies suggest that the extractive industry generates at least some short-run positive effects on the employment level and wages across a number of sectors. The mechanisms through which this impact is felt at the local level is intrinsically linked to the redistribution of resources and their use. The literature, such as the evidence produced by Berman et al. (2017), has shown that mining activity is linked to conflict in African countries for the capture of resources. This is contrary to the evidence presented by Bhattacharyya et al. (forthcoming), who find no significant evidence of the impact of resources on the probability of conflict but find a positive impact on economic development. In the case of oil in Brazil, Caselli et al. (2013) find that the increase in public-goods spending is not proportional to resource windfalls, while Borge et al. (2017), in the case of hydropower in Norway, highlight that revenue inflows results in lower public goods efficiency.

The impact of resource abundance at the local level remains of interest, in particular its impact on the structure of the local economy, as well as on local variables such as inflation and wages, as suggested by the DD framework. To answer these questions, the reliance on firm-level data in the developing-country context is still scarce. More recent papers, such as Crust et al. (2015) in the case of Indonesia, show that resource production has been associated with higher wages, with districts rich in oil and gas seeing a rise in the wage rate by as much as 9.4% compared to countries with half the amount of such resources.

Other empirical evidence of the impact of oil on wages is mainly found in analysis of the manufacturing sector. Allcott and Keniston (2014) argue that manufacturing sector output is reduced following a boom at the local level if local manufacturing wages rises and prices are exogenous, i.e. they do not rise. By assessing oil-rich economies in the 1970s, Smith (2014) underlines the impact of bust-boom cycles on the manufacturing sector. He points to the fact that exports, productivity and employment levels increase during the boom, and the reverse is true during a bust. Cavalcanti et al. (2015), focusing on Brazil, compared municipalities where oil was discovered to other municipalities with drilling activities but no discovery. In doing so, they made sure that no confounding factors, such as institutions or infrastructure that could affect both oil production and manufacturing activity, were responsible for the difference between oil-rich and other municipalities' GDP. They found that oil production positively impacts GDP per capita and the pace of urbanisation, and even has positive spillover effects on services and manufacturing GDP. This chapter will contribute to the literature by assessing the effect of resources inflows on wage determination at the firm level. This is highly relevant as part of the Dutch Disease mechanism is driven by increasing wages that crowd out the tradable sector.

Thus, using Nigeria as the basis for my analysis, this chapter investigates the specific impact of oil abundance on wage determination in an emerging resource-rich economy. My aim is to examine whether firms in oil and gas extraction regions offer higher wages (i.e. oil revenue is a key factor impacting the wage determination process) and thereby contribute to wage inequality in the country. Nigeria provides an ideal setting for studying the potential impact of resource abundance on wage determination because it is a relatively large emerging economy with oil extraction activities concentrated in one specific region of the country (i.e. the South-South region). In addition, the country's fiscal-federalism policy implies that this region receives a large proportion of oil revenue (13% of oil revenue over and above the share communally distributed globally among the different states).

As far as it is known, this study is the first one to provide Nigerian firm-level evidence on the impact of oil abundance at the subnational level on wage determination and the contribution of resource revenues to wage inequality in the country. Existing studies on Nigerian firm-level wage determination (Aighokan 2011; Malik et al. 2012; Söderbom et al. 2002) do not take into account the possible role played by the abundance of oil in wage determination. Finally, beyond the well-documented impact on the environment and/or the political economy of the region, as illustrated by Zinn (2005) Caselli, (2006) and Kurečić (2015), this research hints at the economic impact of the oil revenue distribution mechanism which has been a source of debate (see Ekpo (1994) and Adedotun (1991)) on firms' level of employment and the country's competitiveness.

5.2 Theoretical Framework and Empirical Implementation

A number of studies related to the Dutch Disease literature have shown that countries rich in resources experience an overall increase in wages. Through this analysis, this impact will be demonstrated at the subnational level (i.e. the administrative division called the 'geopolitical level'[8]) for a country such as Nigeria by asking the following questions: Does the abundance of oil, through higher receipts from the central government relative to other states, affect the wage level? And if so, does oil abundance play a role in explaining wage inequality across Nigerian firms?

The general literature on wage determination is rich and vast, drawing from microeconomic and firm theory. This literature shows that wages are unequal because of variations in skill, ability, experience, gender, race, and other characteristics of workers. Even after adjustments are made for these differences, firm size and productivity can be important in affecting wage rates (Akerlof, 1984; Kahn and Cume, 1987; Donohue and Heywood, 2004). A number of factors can explain this. Experimental research conducted by Charness and Kuhn (2007) concludes that a phenomenon of gift exchange is prevalent and strong among workers and firms as a larger wage (a gift to labour) results in larger efforts from employees (a gift to the firm). Alternatively, larger and more productive firms pay higher wages out of 'fairness' considerations (Amiti and Davis, 2012) which, in turn, succeeds in producing goods that can be exported, even after adjusting for

[8] Nigeria is composed of thirty-six states which are distributed between the six geopolitical zones. These six geopolitical zones are used to amalgamate related ethnic groups and to allocate resources (i.e. economic, political and social resources are frequently assessed and shared across the zones).

skilled employment, by exporting firms (Verhoogen, 2008). As noted in Chapter 3, the South-South region appears to be relatively more productive than other parts of the country. Thus, gift sharing is the position from which the question of interest will be approached.

Gift sharing (i.e. higher wages) is the result of oil revenue. In the context of a country like Nigeria, it is difficult not to consider the fact that a booming sector such as oil production and its redistribution may affect wages (the reliance on oil revenue is presented in the fiscal section in Chapter 2). Indeed, as presented by Brunstad and Dyrstad (1997), who analysed the resource boom in Norway, wages in the resource-rich context are driven by the demand and cost-of-living effects, which combines aspects of the Dutch Disease and the literature on local demand shocks. This provides the broader framework for the analysis in this paper. This mechanism is composed as follows:

The **demand effect** corresponds to the labour market impact of increased demand in sectors providing goods and services to the resource sector. In the case of inelastic supply, the prices of these goods will increase, adding upward pressure on wages. This is needed to attract labour to respond to the added demand. Thus, sectors across the country with tight links to the booming sectors will experience a wage increase, independently of their location. For example, the booming sector can increase demand for steel; therefore, steelworkers anywhere in the country will see a rise in demand for their labour. This causes a marked non-negative effect on wages (similar to Dutch Disease).

Thus, the demand effect puts upward pressure on wages, while the **cost-of-living effect,** if greater, can push wages in the opposite direction. This effect reflects the fact that oil production is located in a specific region; as a result, several markets will be under pressure given limited supply (at least in the short run), such as housing markets, in which prices will be pushed upwards. Under this effect, local inflation is expected to increase, thus affecting the local economy independently of specific sectors. This effect could put a downward pressure on labour supply; thus, the higher nominal wage could be offset by lower real-wages. Reduced real wages could result in increased supply in other sectors and other regions, generating pressures on wages. This effect can be in specific sectors.

In the conclusion of their paper, Brunstad and Dyrstad (1997) found that demand and cost-of-living effects originating from the resource sector can have an opposite impact on nominal wages and represent a significant contributing factor to wage differentials at the occupational and regional levels. The cost-of-living effect is likely to exert a non-negative downward pressure on wages in the region; while the demand effect will put a non-negative upward pressure on nominal wages. The combined effect is that the resource sector will tend to contribute to sectoral and regional wage differentials. Nevertheless, the pass-through of increased cost of living resulting from the boom to real wages, is likely to be smaller than nominal wage differentials, reflecting labour supply and demand elasticities. Given the scarce data, this analysis will use a simpler wage equation to empirically test the impact of oil in wage determination in Nigeria.

5.3 Country Background

5.3.1 "Point Resource" - Oil Produced in a Specific Region

Oil revenue, as was shown in Chapter 3, flows to the Nigerian government's coffers through its state-owned enterprise – the Nigerian National Petroleum Corporation - which is responsible for enforcing the oil-production signed agreements between the government and the private oil companies. Since the return to democracy in 1999, the Nigerian constitution indicates that at least 13% of revenue must be transferred to the oil-producing states. (Nigeria UNDP, 2006). To complement these revenues, these oil-producing states and local governments, like any other states, receive a share of fifty per cent of net-revenue proceeds (after deduction of first charges).

Nigerian oil exploration and production activities are concentrated in the South-South Geopolitical region, also known as the Niger Delta region, producing 97% of the total Nigerian production of 2.5 million barrels per day (the remaining 2% is produced by Ondo state [included in my dummy]). Thus, the share of Imo and Abia states, estimated at less than 15,000 barrels a day each, is too small to impact the state in a similar fashion to other oil-producing states. Indeed, oil production of those two states represents less than 1% of total national production, and the associated revenue in terms of redistribution is relatively small. Revenues from derivation represents about 15% of Imo and Abia states' revenue respectively, compared to over 50% for the other oil-producing states.

5.3.2 Impact of Oil at the State Level

The focus here is on the effect that being located in an oil-producing region has on wages. This is the basis for the dummy variable which is to be included in this analysis. To do this, the framework of Brunstad and Dyrstad (1997) is adjusted and the hypothesis that oil revenue is expected to affect the geopolitical region as described in Chart 32 below is tested.

Chart 32: Impact of Oil Revenue at the Subnational Level

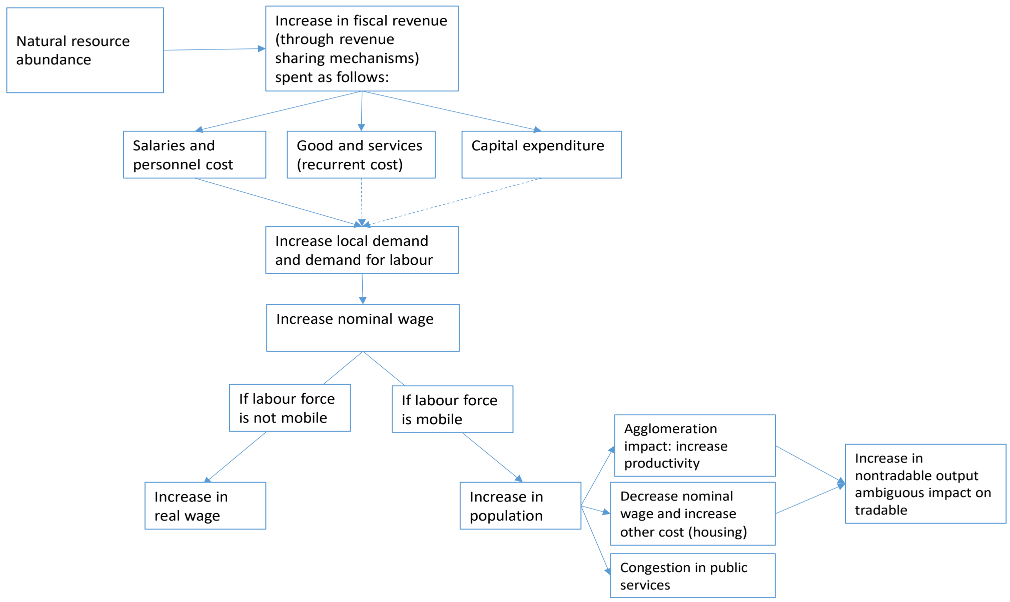


Chart 32 above indicates that, typically, governments in Nigeria divide their resources into two main categories. The capital budget corresponds to a share of the national budget used to finance the country's development projects, such as the construction of key infrastructure, including roads, hospitals, schools, highways, electricity and dams, as well as the purchase of machinery and equipment. Goods and services linked to the capital budget are likely to be sourced abroad (i.e. through the hiring of foreign firms to deliver those durable assets), thus increased demand for these goods and services may not contribute to the local shock. By contrast, the recurrent budget (goods, services and salaries) refers to the financing of related government operations, such as expenditures on personnel, overheads, and infrastructure maintenance. Those expenditures will contribute to the local economy through consumer demand and government demand for local goods and services. Historically, since the 2000s, the capital budget represents 30% of total allocation (CBN data, Ogujiuba et al., 2014) and suffers from severe implementation issues. Over the past decade, data from the CBN indicates that capital budget implementation was volatile and relatively modest, averaging 50%, between 2000 and 2010. This implies that about close to 85% of national expenditure finances salaries or government recurrent spending.

Those trends observed at the federal level are also noticeable at the state level, and this independently of the oil production level. Indeed, as presented by the World Bank report (2011), Federal states in Nigeria have not been able to transform increased revenue received from the federal government, reflecting increased oil revenue, into socio-economic development. This reflects some of the resource curse challenges discussed in section 3, including weaknesses in public expenditure management and state government delivery capacity. Indeed, as the constitution gave greater autonomy to the states and local government and a greater share of federal revenue (accounting for about 50% of consolidated public sector spending, which doubled between 1999 and 2001), Nigeria has found it hard to control the increasing liquidity, inflationary and exchange rate pressures.

Since independence, revenue increases have been generalized across states; however, they also vary considerably in size between states. Not surprisingly, the largest oil producers in the sample have experienced some of the highest revenue increases due, in part, to the increase in natural resource derivation payments, from 1 per cent to 13 per cent. For example, Akwa Ibom and Delta state, the country’s larger oil-producing states, experienced total revenue increases in real terms of about 500 per cent a few years after the return of democracy. For the oil-producing states, revenue from the derivation mechanism is the single largest item in their revenue profile. In general, across all states, receipts from the states' own sources also increased, but by much less, thus deepening their dependence on federation revenues and creating an avenue for patronage between federal authorities and the subnational governments. On average, states collect only 10 per cent of their revenue from their own sources; the remaining 90 per cent comes from federally-collected revenues, compared to 28 per cent and 72 per cent respectively in 1997. These shares are highly correlated with oil revenue; thus, the recent end drop in commodity prices drove this share to about 15 per cent. This share is consistent across all states, with the average revenue being relatively low for the resource-rich states and relatively high for states around the economic capital of the country Lagos, where state collected revenue are above 35 per cent.

On the expenditure side, states' expenditures increased slightly faster than revenues, rising about 330 per cent in real terms soon after the return of democracy. In line with revenue trends, oil-producing states saw their expenditure increase significantly, reaching as high as 10-fold in states such as Delta State compared to only 41 per cent in a Lagos state which is an outlier known for relatively strong public finance systems. Across the different states, expenditure has been dominated by recurrent expenditure on sectors such as personnel and the cost of running government, thus reducing significantly the fiscal space needed for capital investment. On average, recurrent expenditures have constituted 65 per cent on average of total expenditures, and about 75 per cent for oil-producing states. Personnel outlays have accounted for a large and growing share of recurrent expenditures, ranging on average from around 33 per cent in Lagos, to as much as 82 per cent in Cross Rivers State. Several states are now encountering increasing difficulties meeting their wage obligations, evidenced in mounting personnel arrears and frequent strike action by state civil servants. This pressure is exacerbated by the fact that state civil servants' unions, supported by the central labour union, seek to ensure that state salaries match the federal level. This is compounded by a significant increase in the number of civil servants (in line with the resource curse discussion in chapter 3) or the increase in the number of parastatals. All states, on average, have been spending more on capital investment in absolute terms; however, it is apparent that they have been embarking on large projects, paying little attention to economic returns and their poverty-reducing impact. In addition, there is a disconnect between capital and recurrent spending with, overall, a limited consistency between them. To further illustrate, the inefficient spending general administration gets the largest share of state spending, reflecting the cost of state bureaucracy, while growth in education and health spending has lagged behind growth in other sectors

Those trends highlight how state-level spending is fairly consistent in its composition, with the larger revenue received by oil-producing states impacting the scale of the increase in recurrent spending (i.e. salaries) and inefficient spending while impacting negatively revenue collection efforts. As a result, there will be an increased demand for goods/services and labour at the local level to respond to government-driven increased demand. This, in turn, will increase nominal wages.

Another characteristic of importance when considering the effect of oil at the local level is the presence of strong social networks, which can contribute to fragmented markets as well as high search and transaction costs for firms and employees. In line with this argument, Aker et al. (2014 page 1) argue that cross-border transaction costs are reduced when traders are from the same ethnic group. They summarise this as follows: "having a common ethnicity reduces the transaction costs associated with agricultural trade, especially in communications and credit transactions." Although, these findings are not directly linked to the development of the private sector, they provide an explanation for the observed fragmented labour and supplier markets. This points to low labour mobility, and the increase in demand driven by oil revenue given to a state's government is likely to have an impact locally, with limited spillover on other states, or will be mitigated by internal migration. This argument is further confirmed by the enterprise survey data that indicates that, on average, over 60% of firms indicate that their last recruit was found through relatives and friends.

5.4 Empirical Approach

The analysis here uses pooled firm-level data from Nigeria covering the years 2007, 2009 and 2013 collected by the World Bank's Enterprise Survey Unit to examine some of the factors driving wages and to assess if oil is a key underlining factor that contributes to wage inequality. To do so, first a wage equation at the firm level is estimated and the impact of oil on wage determination is established. Then, wage inequality is decomposed to reflect its determinants using the linear decomposition technique developed by Wagstaff, et al. (2003). Finally, these results will be used to help to identify the contribution of the different variables, including oil revenue, to firm-level wage inequality.

5.4.1 Wage Equation

Given the data available, the model developed by Teal (1996) is adjusted to reflect the determination of the average wage level at the firm level. The standard equation starts with the form: W = F(H, Fc, We), where W represents a firm's wage rate; H is the set of variables capturing human capital characteristics; Fc is a set of firm-related characteristics; and We is trade-off wage (i.e. wages available in other sectors).

However, given data limitation, an adjusted version of this wage equation is used here in line with Devkota et al. (2015) and Şeker (2012). Firm-level wages are determined by the size of the firm, its exposure to international trade, and other factors, including, in particular, firm-level characteristics like operating in a geopolitical region receiving significant oil revenues. Firm-specific factors provide controls that indicate whether older firms with a higher share of permanent workers or firms with any union activity pay higher wages. This also indirectly provides information on important labour-specific characteristics.

The wage equation in a linear form can thus be written as follows:

$$w_i = \beta_0 + \beta_1 firmsize_i + \beta_2 fxposure_i + \sum_{j=3}^{k} \beta_j X_{ji} + \gamma_{yr} D_{yr} + \gamma_{ind} D_{ind} + \gamma_{rgn} D_{rgn} + \gamma_{oil} D_{oil} + \varepsilon_i$$

where subscript i indicates a firm, w is the wage rate, and fxposr is the foreign exposure dummy based on the fact that firms with international market-ties perform better than firms purely focused on the domestic market, as illustrated by the World Bank Investment Climate Assessment for Nigeria (2014). The variable Firmsize is firm size given by total sales, sales per worker (an indirect measure for productivity: see Malik et al., 2012) or total employment. Similarly, Dyr, Dind, and Drgn are year, industry and region dummies, respectively. Year effects are added to the model to capture economy-wide shocks that affect wages in the country. The industry and region effects are included to address time-invariant factors for industries and geographic regions. The residuals are assumed to follow a normal distribution with a zero mean and a constant variance. The definitions and descriptive statistics of the different variables of interest are discussed in the previous section. For the purposes of this paper, all βj > 0 are assumed, except the coefficient related to the firm's age.

5.4.2 Calculation and Decomposition of Wage Inequality

The wage equation will help assess the role of firm location (in an oil-producing region or not) on wages. Thus, the concentration index is used to calculate the inequality in wages and other variables mentioned above to assess the weight of a firm's location in explaining wage inequality in Nigeria. This approach could allow policymakers to move from tackling average wage problems to tackling inequalities in wages. This accounts for the diversity of a country such as Nigeria.

This method, borrowed from the health economics literature (see Wagstaff et al. 1991, Konings et al. 2009) allows us to assess the link between inequalities in wages and the variables of interest. It rests on the concept of the relative concentration index (RCI), which consists of ranking, in ascending order, the different firms using the different variables of interest (e.g. share of permanent employees, ages, etc. but excluding wages). The concentration curve for wages will then plot the cumulative proportions of the firms by variables of interest against the cumulative proportion of wages. The concentration index corresponds to twice the area defined by the concentration curve and the 45-degree line (i.e. the equality line).

The full details on the computation of the concentration index are presented in Konings et al. (2009) but briefly summarised below. The starting point is a linear model of the form:

$$w_i = \beta_0 + \sum_k \beta_k X_{ki} + \varepsilon_i \text{ (equation 1)}$$

where w_i is linearly associated to a number of determinants X_{ki} , where (i) means the interested wages outcomes, X_{ki} is the explanatory variables, and ε_i is the error term. Considering the relationship linking the variables w_i and X_{ki} presented in equation 1, the wage relative concentration index (RCI) is as follows:

$$RCI_y = \sum_k \left(\frac{\beta_k \bar{X}_k}{\mu}\right) C_k + \frac{GC_\varepsilon}{\mu} \quad \text{(equation 2)}$$

where μ corresponds to the mean of w, $\bar{X}_k$ is the mean of determinant X_{ki}, and C_k stands for the RCI for X_{ki} (defined as a proportion of C, which is the sum of all the concentration indexes). In the last term, GC_ε corresponds to error term ε_i- the generalised concentration index. This residual is the wage inequality that is not captured by the regressors' variations, thus cannot be calculated. Hence, overall inequality in wages has an explained as well as an unexplained component.

This reduces RCI to the first component of equation (2) and it is estimated through the following equation:

$$RCI_y = \sum_k \left(\frac{\beta_k \bar{X}_k}{\mu}\right) C_k \quad \text{(equation 3)}$$

In equation. (3), C_k can be calculated by using the covariance formula:

$$C_k = \frac{2cov(x_k, r)}{\bar{X}_k} \quad \text{(equation 4)}$$

in which $cov(x_k, r)$ is the covariance between the explanatory variables and the fractional rank of the variable x_k.

As a result, the inequality decomposition will entail estimating equation 1 to obtain the coefficients related to the set of explanatory variables of interest β_k, the average of the wage variable μ and the average of each of the determinants variables $\bar{x}_k$ are then computed.

Furthermore, C_k was computed for all the variables using equation (4). Computing $\left[\left(\frac{\beta_k \bar{X}_k}{\mu}\right) C_k\right]$ gives the absolute contribution of each determinant to wage inequality. Finally, to obtain the relative contribution of the different determinants of wage to the total value of C for each variable, the contribution in C is divided by the total value of C. The analysis was computed using Stata version 13/SE.

5.5 Data

Enterprise Survey data for Nigeria collected by the World Bank Group is used here. The survey was conducted in the years 2007, 2009 and 2013 using stratified random sampling by location, size, and sector. This approach allows for inferences across these different strata. This method is standardised across all countries, thus allowing for cross-country comparisons. All three surveys, completed through interviews, gathered qualitative and quantitative information about the country's overall business environment and its firms' productivity. The information collected covered, among others, topics such as quality of infrastructure, access to finance, regulations, labour, crimes, and perceptions of bottlenecks related to the business environment. Using data gleaned over the three years, a pooled cross-sectional database is constructed of firm-level characteristics for the firms that were selected randomly from around the country. As it was not possible to obtain data to construct firm or sector-specific price deflators, the CPI deflators for the relevant years is used to adjust prices.

The world bank enterprise survey data has some limitations. Indeed, as it is based on interviews, it is possible for the respondent not to communicate accurate information. It is often perceived that survey respondents might have the incentive to under-report sales data as they may fear that it could be used by tax authorities. On the other hand, they may over-report performance in order not to provide information about the true state of their operation to competitors. Din et al. (2012) and Clausen et al. (2010) show that interviewees have a tendency to under-report corruption and over-report the obtention of the International Organization for Standardization certificates, hinting at possible over-reporting of firms' performances and a reluctance to be truthful about how productive and capital intensive their firms are.

Furthermore, the survey only covers the non-agricultural, formal, private sector, thus excluding a significant proportion of economic activity and private sector segments, such as the informal sector. This limitation implies that the analysis may not be representative of economic activity as a whole. In countries like Nigeria, the informal sector accounts for over 60% of GDP (Ogbuabor et al., 2010). Another limitation on the data concerns the relatively low representation of services firms. Services represented over 50% of employment in 2016 (World Bank database). The surveys covered both services and manufacturing firms; however, some interesting modules, such as innovation for example, were not administered to service firms in 2007.

The dependent variable corresponds to wages per-worker in its natural logarithmic form. This was computed by using the ratio between a firm's aggregate wage bill and its number of workers. To test for robustness, the logarithm of wage per-worker was also used.

Several independent variables are analysed to explain wages at the firm level, as suggested by the literature. Total sales, that is sales per worker, and total employment can all affect the wages a firm pays out (Amiti and Davis, 2012; Egger and Kreickemeier, 2009). Sales and employment are alternative measures of a firm's size, and appear in their logarithmic forms. Next, participation in international trade can also affect wages. Based on a firm's participation in exports or imports, a variable fxposr is constructed; this is a foreign exposure dummy which assumes the value of 1 if the firm of interest is engaged in international trade and 0 if not. Besides exports and imports, the surveys also provide information on whether workers at the firm are unionised or participate in union-forming activities. Another key variable is the dummy variable indicating if a firm is located in Nigeria's oil-producing region. The regressions used also control for the age of a firm, the year of a firm's inception, and industry and region-specific effects: see descriptive statistics in the annexe.

Chapter 3 indicates a difference in terms of productivity and TFP between firms in other parts of Nigeria and firms in the South-South region. This chapter aims at exploring the difference in wage determination between oil-producing states and other states in Nigeria. On that basis, the World Bank data set for the different years indicates a number of interesting similarities between those two groups of states. Despite significant revenue from oil sales, the Niger Delta region remains arguably the poorest and least developed area in Nigeria, experiencing a reducing life expectancy (UNDP, 2006: 151-159). Moreover, at a time when oil prices reached historic highs, the power supply and infrastructure deficit remained a challenge, despite the fact that the region is producing most of the country's oil (Omotola, 2006; Ibeanu, 2000).

Indeed, when looking at variables reflecting the business environment, there are some differences between the states of interest and the rest of the country. Using the pooled data set of the years 2007, 2010 and 2014, it can be seen that in terms of a**ccess to power,** 78% of firms in oil-producing states consider that lack of electricity is either a severe or a major constraint to their operations, compared to only 74% of firms in the rest of the country. This also translates into a larger share of sales (12%) being lost in oil-producing states as a result of an unreliable power supply compared to 9% in the rest of the country. Similarly, 59% of firms in the oil-producing states consider that they are facing a lack of infrastructure compared to 53% in the rest of the country. One of the most important key elements of firms' competitiveness is infrastructure, especially the power supply which has not improved since the late 1990s. It is also assumed that only about 30% of roads in Nigeria are paved, and of the close to 200,000 km road network, 67% is under the maintenance of states and local government, therefore depending on oil revenue from the federal government (UNDP, 2006: 151-159).

In terms of access to finance, 57% of firms in oil-producing states consider it to be at least a major constraint, compared to 49% of firms in the rest of the country. Furthermore, these firms consider that the interest rates they face are perceived as more of a constraint than they are by firms in the rest of the country. This results in a higher share of working capital being financed through retained earnings or from relatives in oil-producing states (75%) against only 64% of firms in other part of the country. **Unlike the other business environment indicators, corruption** is perceived as less of an issue in the oil-producing region. Indeed, only 31% of firms in oil-producing states consider that corruption is at least a major constraint to their operations, against 38% in the rest of the country. Further, these firms in the South-South region consider that only 1% of their sales goes to informal payments to government officials, against 2% in the rest of the country. This appears to be somewhat paradoxical given the number of high-level corruption cases reported in these states.

Adeyemi (2012) and Agbiboa (2012) highlight that the Niger Delta region is prone to weak governance by both state and local governments officials. They argue that if monthly revenue allocation were used for the development of the region and geared towards poverty reduction programmes, the region would have made significant socio-economic progress. They illustrate this by using the example of health-related services being allocated half of the governor's expenditure on transportation and the purchase of two helicopters.

Two other elements often associated with weak governance corroborate these tendencies. Access to land, as with corruption, appears to be less of an issue in oil-producing regions than in the rest of country. This results in land, on average, being 2.5 times more expensive in the rest in the country than in the oil-producing states. In the same vein, tax rates and tax administration are perceived to be less of an issue in oil-producing states: 29% and 23% respectively, against 33% and 30% in the rest of the country.

This difficult business environment impacts a number of firms' characteristics. Indeed, on average, firms in the oil-producing regions are about two years older than firms in the rest of the country. This potentially reflects a number of factors, such as the ability of the entrepreneurs. Indeed, entrepreneurs in the South-South region are marginally more experienced than in the rest of the country: 11.5 years against 11 years. In Addition, those entrepreneurs in oil-producing regions are, on average, more educated, with 40% of them holding at least an undergraduate degree, against 32% in the rest of the country. In addition, entrepreneurs in the South-South region are more likely to be in partnership: 20% against 12% in the rest of the country. Similarly, they are more likely to have a board of directors (10% against 5%) and, unlike the rest of the country, they are more involved in running their operations, with only 35% of firms having an appointed manager, against 48% in other parts of the country.

On average, firms in the South-South region employ more labour than their counterpart in the rest of the country. Indeed, the average number of full-time workers is 30.6 in the oil-producing states, against 28.7 in the rest of the country. Similarly, the number of part-time employees is 12.1 in resource-rich states, against 10.6 in other parts of the country. The preferred hiring method also differs across the two groups, with the firms in oil-producing states more likely to hire through their network: 40% against 34% in the rest of the country. This recruitment mechanism potentially explains why firms in oil-producing states are more likely to dismiss employees for personnel reasons: 38% against 33%. Thus, labour regulations are less of a constraint for firms in the oil-rich regions compared to the rest of the country. This could be linked to the fact that, on average, it takes more time to fill a vacancy in the South-South region: 12 weeks against 9 weeks in other parts of Nigeria. Balancing the difficulty to fill a position, a worker in the South-South region is likely to stay longer with the firm, averaging 3 years against 1.5 years in other parts of Nigeria. Moreover, those workers are more likely to be trained: 32% against 24% in other states. This is in line with the World Bank report (2014), arguing that manual skills are more abundant in the northern part of the country compared to the southern part. As a result, in the south, the percentage of firms reporting difficulties to hire decreases with the skills level, with firms finding it harder to identify suitable unskilled production workers compared to managers. Most firms assess the lack of applications and the skills gaps as a constraint.

Furthermore, one could expect wages to be affected by these constraints; however, an analysis by the world bank highlights the fact that labour turnover is not related to wages. Indeed, the report argues that there is a limited turnover among workers, and also points to the fact that there is little correlation between turnovers and wages. This is interesting as it may be expected that workers would be more likely to stay within a company offering higher wages, hinting at the fact that the wages offered meet the expectations of the workers. However, data indicates that workers are more likely to stay with a firm offering a bonus system. Finally, despite entrepreneurs claiming that they do not keep poor performers, the Nigerian labour market appears relatively sticky as firms do not adjust labour requirements to reflect economic conditions, such as lower sales. Additionally, as only a small percentage of entrepreneurs consider labour regulation a major issue, however, there is significant difference between the share of firms declaring that most of their staff are unionised: 12% in resource-rich states, against 8% in the rest of the country. This could a source of wage stickiness adding upward pressures on wages in resource-rich states.

These trends, however, are no different from other non-oil producing neighbouring states in the region, such as Cross rivers for example. Thus, to capture these elements that appear to be ethnic-specific or states-specific, the different regression states dummies are included for consideration; this will capture the lack of mobility, tight networks, education levels and entrepreneur profiles.

The data allows for a closer look at the firm’s finances, which indicate that, in terms of a total wage bill, firms in the oil-producing states pay wages, on average, 25% higher than firms in the rest of the country. Similarly, an average wage bill is, on average, 15% higher in oil-producing states where, on average, they hire relatively fewer employees than firms in the rest of the country. Indeed, on average, firms in non-oil-producing states hire about two people more than firms in the South-South region. In terms of sales (in absolute numbers), on average, small and large firms in the South-South region are performing better than firms in other parts of the country; however, medium-size firms in the rest of country are performing much better. These trends are maintained when sales per worker are considered.

Finally, when considering all other costs of production (excluding wages), on average, costs faced by firms in the oil-producing region are 32% higher than in the rest of the country. These costs are as high as 45% for small firms. This reflects the fact that the Niger delta is not on the major commercial axis of the country, thus the price regimes for goods and services in this geopolitical region is different from those of most other regions. Indeed, prices reflect the fact that the Delta region is difficult to access and that communities are remote; this is compounded by the spending by the oil and gas industry and the much higher earnings of oil sector workers. This puts downward pressure on the average purchasing power in the region by heightening inflation in key services, such as housing, transportation and food products. Furthermore, the oil and gas activities have impacted farmlands and fishing grounds, negatively affecting traditional economic occupations such as fishing and farming, as well as lowering the attractiveness of these activities by weakening possible earnings relative to the oil sector.

This could result in rent-seeking behaviour, as illustrated by the ability to obtain government contracts. Firms in the resource-rich states spend more time dealing with the government: 7% of time against 5% in the rest of the country. As government spending is relatively high due to the fiscal federalism approach, firms in the oil-producing regions are more likely to secure government contracts: 20% against 12% in the rest of the country. To obtain this, those firms are willing to pay a higher proportion of the contract value: 8% in the South-South region, against 5% in the rest of the country. Indeed, firms in the South-South region are more likely to obtain a concession on the firms' location (30% against 24%) and more likely to be owned by the government (56% against 25%) than in the rest of the country.

From the above description of the data, a number of characteristics can be noted, intrinsic to the region and the people within this region, particularly their approach to entrepreneurship in terms of ownership structure as well as mechanisms used to recruit employees; thus, they are likely to be captured by the state-specific dummy variables. In the analysis below, control will be included for other costs which appear to be relatively higher in this region compared to the rest of country, and also the possible impact of wages on government contracts will be assessed.

5.6 Results

5.6.1 Wage Equation

Table 29 below shows regression results for the effect of firm size, productivity and abundance of oil at the geopolitical level on the firm-level wage rate, adjusted for heteroskedasticity. To assess the robustness of the result, different measures of size are included which could affect the wage determination, such as the wage rate and either sales (total or per worker), employment or firm size, as underlined by Devkota (2014). In addition, firms' exposure to foreign markets is also key factor to be considered as several authors find that importing firms also display characteristics of larger size, higher productivity and higher wages than is the case with non-trading firms (Bernard et al., 2007; Lopez, 2005; Seker, 2012). Indeed, when firms are divided into four groups (exporters, importers, both exporters and importers, and none), a positive relationship between labour productivity and import levels is found by Muuls et al. (2009) for Belgian firms. Similar results were found by Vogel et al. (2010) for German manufacturing firms.

Each of the other specifications include different variables reflecting a different measure of firm size, such as sales, sales per worker and total workers employed. Across the different specifications, the coefficient related to the oil dummy variable is significant and fairly consistent in terms of size, ranging from 29.7 ln points to 48.75 ln points. For the third specification, using log employment levels, the dummy variable captures a proportion of the higher sales experienced in the region, partly explaining the drop in the R^2. Other things being equal, the wage paid per worker by firms in the oil-producing region are at least 30% higher. This suggests that oil is a key element in the wage determination process in Nigeria, and has a significant role in the way firms set wages in the South-South region. This figure, as discussed in section 3.4, reflects the fact that, on average, an oil-producing state receives 40% more revenue from the federally collected funds than a non-oil-producing one, pointing to a possible redistribution mechanism through wages.

Firm size is a key determinant of the wage level, with a coefficient ranging from 0.19 to 0.46. This is even more of a determinant than a firm's exposure to external markets. The different control variables are significant under the different dependent variables, apart from age and variable age square (age2), indicating, interestingly, that wages are independent of the firm's age in that older firms are not more likely to offer higher wages.

In addition, across the three specifications, the variable indicating a firm's size is significant, and size plays a role similar to the oil dummy. For example, a 1% increase in sales is associated with a 0.33% higher average wage per worker or 1% increase in sales per worker leads to a 0.47%. increase in the average wage per worker. Similarly, the average per worker wage in medium and large firms is 21% and 53% higher than in a small firm, pointing to the profit-sharing theory (Teal, 1995). This points to wage-sharing mechanisms being set in place to retain workers. This is reinforced by the share of permanent employees' positive impact on wages, as firms offer relatively higher wages per worker to retain their labour force. In addition, the dummy for the presence of a labour union indicates (as expected) a small upwards pressure on average wages when significant. It is also insignificant in the first specifications. This suggests that the role played by labour unions may not be the major factor in wage determination at the firm level.

Foreign exposure, as a proxy for productivity based on the assumption that more productive firms will be able to withstand international competition, does not significantly impact firm average wage per worker. When considered with total sales (model 1), it turns out to be both significant and negative, implying that export-orientated firms have to pay a lower wage to maintain a degree of competitiveness. Moreover, when labour employed is used to represent firm size, we find that firms engaged in international trade provide about 27% higher wages than a typical non-trading firm. This is in line with the theory suggesting that firms are experiencing greater efficiency because of their ability to withstand external competition urging the payment of higher wages. In the same specification, a 1% increase in employment leads to about a 0.2% higher wage. Although firm exposure is likely to play a role in wage determination, its role is ambiguous and not as clear as suggested by the literature.

Table 29: Estimate Log Wage Per Worker and Relevant Variables

Estimation summary - Dependent var is ln (per worker wage cost)

	Model 1 Coeff./Se.	Model 2 Coeff./Se.	Model 3 Coeff./Se.
oil_dummy	0.2975*** (0.06)	0.3050*** (0.06)	0.4875*** (0.08)

Fexposure	-0.1084*	0.0470	0.2687***
	(0.06)	(0.05)	(0.07)
Permlshr	0.0133***	0.0077***	0.0164***
	(0.00)	(0.00)	(0.00)
Labunion	-0.0005	0.0007**	0.0011***
	(0.00)	(0.00)	(0.00)
Age	-0.0024	0.0020	0.0031*
	(0.00)	(0.00)	(0.00)
age^2	0.0000	-0.0000	0.0000
	(0.00)	(0.00)	(0.00)
ln(sales)	0.3266***		
	(0.01)		
ln(pw sales)		0.4683***	
		(0.01)	
ln(labour)			0.1959***
			(0.01)
_cons	5.1079***	4.6013***	9.2426***
	(0.15)	(0.16)	(0.14)
Aic	7336.30	6768.05	9426.82
Bic	7698.77	7130.52	9789.29
r2	0.6050	0.6492	0.3883
N	4782	4782	4782

In all the models, dummy variables controlling for years, industry (SIC level 2, revision 2) and states-related dummy variables are included.
Standard errors are in the parentheses and are robust.
* p<0.1, ** p<0.05, *** p<0.01
source: Author's estimations

5.6.2 Wage Equation Robustness Check

To further asses the robustness of these results, a similar analysis was carried out using the total wage bill as a dependent variable (see Table 30 below). This result is fairly consistent with the size of the oil dummy, ranging from 27% to 49%. However, the size of the different parameters presents more deviations from the values presented, as in Table 30, and they all present results in line with theoretical expectations and are, in most cases, significant.

Table 30: Estimated Total Wage Bill and Relevant Variables

Estimation summary (Dependent var is ln (Total wage cost))

	Model 4 Coeff./Se.	Model 5 Coeff./Se.	Model 6 Coeff./Se.
oil_dummy	0.2734***	0.4833***	0.4875***
	(0.08)	(0.12)	(0.08)
Fexposure	-0.1317*	0.7845***	0.2687***
	(0.08)	(0.14)	(0.07)
Permlshr	0.0011**	-0.0052***	0.0164***
	(0.00)	(0.00)	(0.00)
Labunion	0.0016***	0.0052***	0.0011***
	(0.00)	(0.00)	(0.00)
Age	0.0055***	0.0186***	0.0031*
	(0.00)	(0.00)	(0.00)
age^2	-0.0000	-0.0001***	0.0000
	(0.00)	(0.00)	(0.00)
ln(sales)	0.6847***		
	(0.01)		
ln(pw sales)		0.5838***	
		(0.02)	
ln(labour)			0.1959***
			(0.01)
Med. 20-99			

Large > 100			
_cons	3.2107***	6.6515***	9.2426***
	(0.19)	(0.30)	(0.14)
Aic	8408.55	12289.53	9426.82
Bic	8771.01	12652.00	9789.29
r2	0.8156	0.7849	0.5719
N	4782	4782	4782

In all the models, dummy variables controlling for years, industry (SIC level 2, revision 2) and states-related dummy variables are included.
Standard errors are in parentheses.
* p<0.1, ** p<0.05, *** p<0.01
source: Author's estimations

As before, to assess the robustness of the oil dummy, it is replaced with the amount of revenue received by each state's government (computed from the Central Bank Statistical Bulletin 2016). In doing so, similar results were obtained (see Table 31), with the coefficient being positive and significant, pointing to the role played by oil revenue in wage determination, resulting in a premium of at least 10%. This was achieved using both average wage cost per worker (models 1.1, 2.1, 3.1) and total wages (models 4.1, 5.1 and 6.1).

Table 31: Estimate Using Different Proxies for oil revenue

Estimation summary (Dependent var is ln (per worker wage cost) for model 1.1.; 2.1.and 3.1.and Dependent var is ln (Wage cost) for model 4.1; 5.1.and 6.1.

	Model 1.1	Model 2.1	Model 3.1	Model 4.1	Model 5.1	Model 6.1
	Coeff./Se.	Coeff./Se.	Coeff./Se.	Coeff./Se.	Coeff./Se.	Coeff./Se.
l_grants_stt	0.1486**	0.2341***	0.1032***	-0.0077	0.3430**	0.1032***
	(0.02)	(0.03)	(0.02)	(0.02)	(0.02)	(0.02)
Fexposure	0.1481*	0.2736***	0.2998***	0.1060*	0.0732	0.2998***
	(0.08)	(0.14)	(0.07)	(0.06)	(0.05)	(0.07)
Permlshr	0.0120**	-0.0089***	0.0169***	0.0131***	0.0072***	0.0169***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Labunion	0.0016***	0.0056***	0.0009**	0.0006*	0.0007**	0.0009**
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Age	0.0047***	0.0168***	-0.0001	0.0036**	0.0011	-0.0001
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
age^2	-0.0000	-0.0000	0.0000*	0.0000	0.0000	0.0000*
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
ln(sales)	0.7090***			0.3416***		
	(0.01)			(0.01)		
ln(pwsales)		0.6650***			0.4966***	
		(0.02)			(0.01)	
ln(labour)			1.2635***			0.2635***
			(0.01)			(0.01)
_cons	2.8244***	5.4585***	9.1247***	5.0466***	4.3349***	9.1247***
	(0.18)	(0.31)	(0.15)	(0.15)	(0.16)	(0.15)
Aic	8655.28	12827.74	10008.80	7653.20	7097.61	10008.80
Bic	8797.67	12970.14	10151.20	7795.60	7240.01	10151.20
r2	0.8031	0.6287	0.7386	0.5718	0.6188	0.4993
N	4782	4782	4782	4782	4782	4782

In all the models, dummy variables controlling for years, industry (SIC level 2, revision 2) and states-related dummy variables are included.
Standard errors are in parentheses.
* p<0.1, ** p<0.05, *** p<0.01
source; Author's estimations

Overall, the obtained results align with the DD theoretical prediction as they suggest that the mere presence of oil is in general associated with higher wages. Indeed, the total wage bill and average wage of firms in oil and gas producing geopolitical regions is higher than other non-oil-producing regions. This analysis also indicates that firm size plays a significant role in wage determination. Thus, oil abundance will contribute to wage inequality across the country.

Furthermore, as presented in Chapter 3, firms in the South-South region possess greater efficiency levels compared to firms in other parts of the country. Thus, it might be that the higher wage is just the result of higher productivity in that region. Based on the assumption that exporting firms are more productive, introduced into the different specifications is an interaction dummy between foreign exposure (fexposure) and the oil dummy. Complementary to the per-worker sales, this interaction term will capture the impact of being located in the oil-producing region on wages paid by firms able to export, thus assumed to be more productive.

Table 32 below indicates that among exporting firms expected to be more productive, there is a difference in wages, which is linked to the abundance of oil at the local level. The interaction coefficient term is found to be positive and significant across the different specifications. Thus, on average, productive firms in the South-South region pay wages depending on the specifications, between 10% and 19% more than other exporting firms. similar results were obtained using the total wage bill as the dependent variable (not reported).

Table 32: Estimate Including Interaction Terms Between Oil and Foreign Exposure

Estimation summary (Dependent var is Ln (per worker wage cost) and interaction term between the oil dummy and foreign exposure.

	Model 1.2 Coeff./Se.	Model 2.2 Coeff./Se.	Model 3.2 Coeff./Se.
oil_dummy	0.2941*** (0.06)	0.3097*** (0.06)	0.4841*** (0.08)
Fexposure	-0.1218* (0.06)	0.0654 (0.06)	0.2549*** (0.08)
Permlshr	0.0133*** (0.00)	0.0077*** (0.00)	0.0164*** (0.00)
Labunion	-0.0005 (0.00)	0.0007** (0.00)	0.0011*** (0.00)
Age	-0.0024 (0.00)	0.0020 (0.00)	0.0031* (0.00)
age^2	-0.0000 (0.00)	-0.0000 (0.00)	0.0000 (0.00)
ln (sales)	0.3267*** (0.01)		
interaction	0.1547** (0.06)	0.0960* (0.05)	0.1919*** (0.06)
ln (pw sales)		0.4683*** (0.01)	
ln (labour)			0.1961*** (0.01)

_cons	5.1104***	4.5969***	9.2451***
	(0.15)	(0.16)	(0.14)
Aic	7338.12	6769.66	9428.70
Bic	7707.06	7138.60	9797.64
r2	0.6050	0.6492	0.3884
N	4782	4782	4782

In all the models, dummy variables controlling for years, industry (SIC level 2, revision 2) and states-related dummy variables are included.
standard errors are in parentheses.
* p<0.1, ** p<0.05, *** p<0.01
source; Author's estimations

In order to assess the relationship between location and price, total other costs (excluding wages) are added to the model. This is justified by the fact that the discussion above (section 5.5) points to the fact that prices are, on average, higher in the oil-producing region compared to the rest of the country. Table 33 below, using average wage per worker as dependent, points to the fact that the dummy variable captures parts of the price effect as the associated coefficient increases when the price of other inputs is included. The upwards movement reflects the fact that other costs have a negative impact on wages. Similarly, this additional variable absorbs part of the impact captured by the foreign exposure dummy. This means that other total costs impact the ability of firms to export.

Table 33: Estimate Including other costs

Estimation summary (Dependent var is Ln (per worker wage cost) and additional cost variables (excluding wages).

	Model 1.2 Coeff./Se.	Model 2.2 Coeff./Se.	Model 3.2 Coeff./Se.
oil_dummy	0.3350***	0.3590***	0.5547***
	(0.05)	(0.05)	(0.05)
Fexposure	-0.0632*	0.0658	0.0745**
	(0.04)	(0.04)	(0.03)
Permlshr	0.0131***	0.0086***	0.0109***
	(0.00)	(0.00)	(0.00)
Labunion	-0.0007	0.0007**	0.0006***
	(0.00)	(0.00)	(0.00)
Age	-0.0016	0.0021	0.0017*
	(0.00)	(0.00)	(0.00)
Age^2	-0.0000	-0.0000	0.0000
	(0.00)	(0.00)	(0.00)
ln cost (excl.wages)	-0.1018***	-0.0475***	-0.2838***
	(0.01)	(0.01)	(0.00)
ln (sales)	0.3973***		
	(0.02)		
ln (pw sales)		0.3571***	
		(0.01)	
ln (labour)			0.1776***
			(0.01)
_cons	5.5535***	5.470***	6.7561***
	(0.11)	(0.16)	(0.09)
Aic	7335.32	6768.96	9427.29
Bic	7704.41	7134.81	9793.57
r2	0.6261	0.6529	0.6101
N	4782	4782	4782

In all the models, dummy variables controlling for years, industry (SIC level 2, revision 2) and states-related dummy variables are included.
standard errors are in parentheses.
* p<0.1, ** p<0.05, *** p<0.01
source; Author’s estimations

Another channel that was explored from the descriptive statistics discussion in section 5.5 is the ability of the firms to attract government contracts. In order to do so, a dummy variable is introduced into the initial model specifications, capturing the fact that the firm bids for a government contract. Table 34 below presents the results, using wage per worker as a dependent variable and sales per worker as the measure of a firm’s size. These indicate that the dummy variable is positive and significant, pointing to the fact that the ability to bid/obtain government contracts impacts wage levels positively. When the interaction terms associating the location in an oil-producing region and the ability to seek/obtain are introduced in the model, government contracts, on average, offer higher wages. This is in line with the rent sharing theory that can be associated with the DD framework.

Table 34: Estimate Including variable capturing government contracts

	Model 2.2 Coeff./Se.	Model 2.2 Coeff./Se.
oil_dummy	0.2875*** (0.08)	0.2529*** (0.06)
Fexposure	0.0351 (0.06)	0.0318 (0.06)
Permlshr	0.0076*** (0.00)	0.0077*** (0.00)
Labunion	0.0005** (0.00)	0.0005** (0.00)
Age	0.0020 (0.00)	0.0020 (0.00)
age^2	-0.0000 (0.00)	-0.0000 (0.00)
ln (pw sales)	0.4221*** (0.01)	0.4237*** (0.01)
Gov_contract	0.1371** (0.06)	0.1287** (0.05)
interaction		0.0860* (0.05)
_cons	4.6418*** (0.15)	4.6969*** (0.16)
Aic	6768.96	6873.53
Bic	7135.20	7258.11
r2	0.6592	0.7214
N	4782	4782

In all the models, dummy variables controlling for years, industry (SIC level 2, revision 2) and states related dummy variables are included.
Standard errors are in parentheses
* p<0.1, ** p<0.05, *** p<0.01
source; Author’s estimations

Thus, wages and location are shown to be closely related as a wage premium is paid in the region receiving larger revenues from the oil sector. The analysis does not allow the disentanglement of the revenue and location impact described by Brunstad and Dyrstad (1997) but, given the limited labour mobility across the country, wages are being pushed upwards. This is similar to Brunstad and Dyrstad's findings in the Norwegian case, where a booming sector was shown to impact nominal wages through wage differentials across sectors and regions. Further, the demand effect can potentially positively impact nominal wages across the different labour submarkets; while the cost of living effect can put a negative pressure on regions further away from the oil-producing zones. This analysis also points to the existence of a rent-sharing mechanism as presented in Chapter 3, where it was established that firms in this region were among the most productive in the country. Moreover, assuming that other than a firm's exposure, sales per worker captures productivity levels, thus it can be noted that higher productivity results in higher wages paid. This in is in line with the literature produced by Charness and Kuhn (2007), who found that a phenomenon of gift exchange does exist among workers and firms.

In addition, this analysis points to the fact that foreign exposure does not result in higher wages, in contrast to the general prediction of the literature. However, as pointed out by Malik et al. (2008), unlike firms in East Asia which are export-oriented, Nigerian firms are inward-looking, targeting mainly the large domestic market. Thus, these inward-looking firms do not face the competition of international markets and, as a result, can offer higher wages, which do not necessarily reflect productivity levels. This observation is very much in line with the assumptions of the Dutch Disease framework, implying a greater focus on non-tradable activities pushing wages upwards, making the tradable sector less competitive. This will be further explored in the next section, which looks at the difference between services and manufacturing activities.

Finally, this analysis indicates that a firm's size, which has been assessed by different variables, matters more than its age in terms of wage determination. The age of a firm plays a weak role in determining wages, while the size seems to have a stronger role in that smaller firms will pay a relatively lower average wage per-worker compared to larger firms. This probably contributes to wage inequality in Nigeria (assessed in the next sections) and could have interesting policy implications. Similarly, the price of other inputs and the ability to obtain government contracts matter for wage determination. This points to the fact that the Nigerian fiscal federalism results in local inflation, and possibly encourages rent-seeking behaviour assimilated to the rent sharing mechanisms.

5.6.3 Differences between Services and Manufacturing Sectors

It is important to note that firms in the manufacturing sector[9] and firms offering services are both affected by the presence of oil; however, the dummy coefficient in Table 35 and Table 36, when significant, is higher for manufacturing firms. This implies that oil abundance at the geopolitical level matters more for these firms; i.e. a manufacturing firm in the South-South region will pay a premium of between 32% and 55% compared to a firm outside the region, while this range is of 20-42% for a services firm. This in line with the work of Brunstad and Dyrstad (1997) and the prediction of the DD, pointing to the effect of oil revenues extending beyond the booming sector and affecting the entire local economy, including the non-tradable sector. The impact is less regarding the services sector as it is a relatively competitive sector and offers more homogeneous goods.

Among the different firms, independent of the sector, size matters as larger firms offer higher wages. This is true for the different proxy of size that was used in the different specifications. However, the size effect is more pronounced for services firms than manufacturing firms. Again, given the fact that firms in the tradable sector face external competition, there is a limit on the premium they can put on wages. Thus, among firms of similar size, wages in the service sector will be higher.

In addition, in the different sectors, the role played by labour unions seems to differ. In the services sector, the labour union plays a more subdued role in wage determination. This could reflect the fact that the sector is very diverse and historically less tolerant towards labour actions (see George et al., 2012). The opposite is true of the manufacturing sector, where labour unions do have an impact on wage determination; it is significant but with a very small coefficient of 0.002. Similarly, age is less relevant for services firms than for manufacturing ones.

Finally, looking at the issue of foreign exposure, the role of the ability to export is unclear for services firms across the different specifications, and when significant, it has a negative impact

[9] This sector includes firms in the textile, garment, food, machinery, electronics, chemicals, wood, plastic materials, and other manufacturing. Firms in the services sectors include construction, IT services, retail and wholesale trade and hotels and restaurants.

on wages. This highlights that in the Nigerian market, services allow firms to pay higher wages if not under the pressure of having to compete internationally. Furthermore, when looking at the interaction variable between foreign exposure and the oil sector, it is clear that firms located in the oil-rich region pay a higher premium on wages than their counterparts in other parts of the country. These results also point to the cost of living effect, where the abundance of oil also impact sectors other than the oil sector. Thus, it reinforces the message that oil has an impact that cuts across various sectors of the economy, as suggested by the DD framework.

When looking at firms in the manufacturing sector, the ability to export turns out to have a positive impact on wages. This effect can be very significant, as illustrated by the coefficient in Table 36, below. This corresponds with the literature, as more productive firms are then able to share the returns of productivity with their workers. However, the location and abundance of oil at the local level still matters as exporting firms in the South-South region pay more than similar exporting firms in other regions.

Table 35: Estimate for the Services Sector Only

	Model 1.3 Coeff./Se.	Model 2.3 Coeff./Se.	Model 3.3 Coeff./Se.	Model 1.4 Coeff./Se.	Model 2.4 Coeff./Se.	Model 3.4 Coeff./Se.
oil_dummy	0.2050**	0.2867***	0.4231***	0.2042**	0.2885***	0.4099***
	(0.09)	(0.09)	(0.11)	(0.09)	(0.09)	(0.11)
fexposure	-0.2264**	-0.1241	0.1759	-0.2375**	-0.0992	0.0054
	(0.10)	(0.10)	(0.14)	(0.12)	(0.11)	(0.15)
Permlshr	0.0135***	0.0077***	0.0178***	0.0135***	0.0077***	0.0177***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Labunion	-0.0010**	0.0003	0.0001	-0.0010**	0.0003	0.0001
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Age	-0.0047	-0.0009	0.0004	-0.0047	-0.0009	0.0002
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
age^2	0.0001	0.0000	0.0000	0.0001	0.0000	0.0001
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
In (sales)	0.3493***			0.3492***		
	(0.01)			(0.01)		
In (pw sales)		0.4774***			0.4777***	
		(0.01)			(0.01)	
In (labour)			0.2256***			0.2250***
			(0.02)			(0.02)
Interaction				0.2697***	0.1195*	0.1514*
				(0.07)	(0.07)	(0.08)
_cons	4.8155***	4.4339***	8.9551***	4.8169***	4.4303***	8.9618***
	(0.15)	(0.16)	(0.13)	(0.15)	(0.16)	(0.13)
Aic	5134.27	4814.77	6658.85	5136.24	4816.59	6656.17
Bic	5431.85	5112.35	6956.43	5439.89	5120.25	6959.83
r2	0.6078	0.6450	0.3691	0.6078	0.6450	0.3700
N	3207	3207	3207	3207	3207	3207

In all the models, year, industry and regional effects are controlled.
Standard errors are in parentheses.
* p<0.1, ** p<0.05, *** p<0.01
source: Author’s estimations

Table 36: Estimate for the Manufacturing Sector Only

	Model 1.5 Coeff./Se.	Model 2.5 Coeff./Se.	Model 3.5 Coeff./Se.	Model 1.6 Coeff./Se.	Model 2.6 Coeff./Se.	Model 3.6 Coeff./Se.
oil_dummy	0.3861***	0.3165***	0.5194***	0.3929***	0.3256***	0.5539***
	(0.09)	(0.08)	(0.11)	(0.09)	(0.08)	(0.11)
fexposure	0.0226	0.1445**	0.3171***	0.0366**	0.1628**	0.3885***
	(0.07)	(0.06)	(0.08)	(0.07)	(0.06)	(0.08)
Permlshr	0.0126***	0.0075***	0.0139***	0.0126***	0.0075***	0.0139***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Labunion	0.0008	0.0014***	0.0029***	0.0008	0.0014***	0.0029***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Age	-0.0004	0.0035**	0.0058**	-0.0004	0.0035**	0.0059***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
age^2	0.0000	-0.0000*	0.0000	0.0000	-0.0000*	-0.0000
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
In (sales)	0.2710***			0.2706***		
	(0.01)			(0.01)		
In (pw sales)		0.4394***			0.4388***	
		(0.02)			(0.02)	
In (labour)			0.1441***			0.1421***
			(0.02)			(0.02)
Interaction				0.2125**	0.2580**	0.1873**
				(0.09)	(0.10)	(0.09)
_cons	6.0901***	5.0044***	9.6994***	6.0921***	5.0065***	9.6895***
	(0.23)	(0.24)	(0.18)	(0.23)	(0.24)	(0.18)
Aic	2105.87	1880.27	2638.41	2107.70	1881.92	2637.17
Bic	2368.60	2143.00	2901.15	2375.80	2150.02	2905.27
r2	0.6115	0.6633	0.4552	0.6115	0.6634	0.4563
N	1575	1575	1575	1575	1575	1575

In all the models, year, industry and regional effects are controlled.
Standard errors are in parentheses.
* p<0.1, ** p<0.05, *** p<0.01
source: Author's estimations

To conclude, firm size, oil abundance and wages are closely related. The smaller the size of a given firm, the lower the wage per worker, and the larger the size of a firm, the higher the wage per worker. In addition, oil abundance undeniably affects firms, with firms in the oil-producing geopolitical region paying a premium on labour inputs. This premium is higher for firms operating in the manufacturing sector (i.e. tradable) than those in the services sector (i.e. non-tradable). This indicates that oil at the local level has an impact on wages that affect the different sectors of the economy: both the manufacturing and services sectors. This leads to a further exploration of wage inequality and an assessment of the role played by each factor, such as oil, in explaining wage inequality in Nigeria.

5.6.4 Wage Decomposition and Wage Inequality

5.6.4.1 Gini index

The Gini index estimated for the entire sample, and for different types of firms according to their size, is presented below, along with the related Lorenz curves (see the annexe for the different sectors). The wage inequality in Nigeria (the wage Gini), using the average log million Naira wage per worker cost paid by firms, stands at 0.43.

Table 37 below indicates that for the whole sample, inequality is larger among large and small firms, while medium-sized firms are less unequal in terms of wages. Looking at the different sectors, inequalities are overall higher among the firms operating in the services sector (0.49) when compared to the 0.38 for manufacturing firms. This reflects the heterogeneity of firms operating in the services sector. This further explains why greater inequality exists among small firms than among the small services firms (0.50) when compared to the figure of 0.33 among small manufacturing firms. This trend is inverted when looking at larger firms, as inequality is greater among large manufacturing firms (0.44) when compared to their large service counterparts (0.33). This indicates that, as firms grow, practices homogenise, and this is notable in terms of wages. This can be explained by larger firms being more likely to operate in the formal sector and are thus more compliant with labour laws. However, regarding manufacturing firms, the homogeneity of their products pushes for more standardised practices, and they are thus relatively less informal. Greater inequality among larger manufacturing sectors could be explained by the "efficiency wage theory", which argues that, as firms grow, they may be reducing their costs by increasing wages due to labour market rigidity and high search costs.

Table 37: Wage Inequality - Gini Coefficients

	Average wage cost (full sample)	Average wage cost (services firms)	Average wage cost (manufacturing firms)
Small (5-19)	0.4095	0.5012	0.3341
Medium (20-99)	0.3879	0.4118	0.3667
Large (100+)	0.4237	0.3320	0.4425
Total Sample	**0.4255**	**0.4855**	**0.3778**

source: Author's estimations

5.6.4.2 Contribution of the Different factor: Wage Decomposition

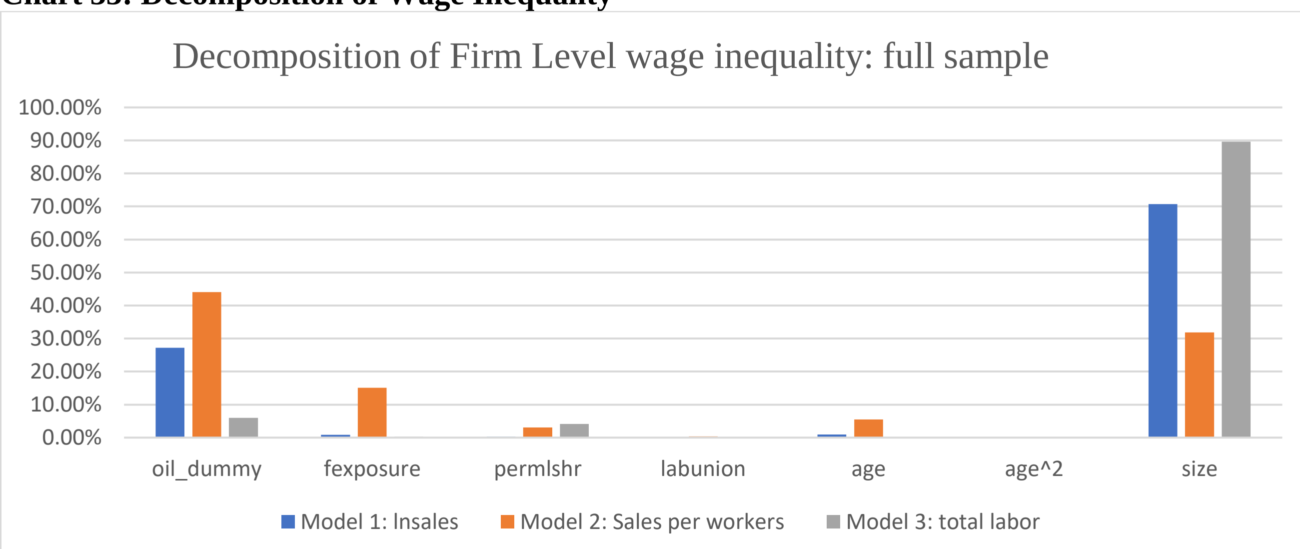
Wage inequality can be deconstructed into the determinants of wage, as indicated by equation (1) above and the steps described above. The decomposition is done for three separate specifications (Model 1, 2 and 3, Table 29), the results of which appear in Table 38 and Chart 33 below. These findings show that oil contributes to at least 6% of wage inequality observed in Nigeria (using labour as a proxy for size). This contribution is as large as 44% when the per worker sales as proxy per-size are used. The difference between these results can be imputed to the per worker sales variable which "dilutes" the impact of size reduction and thus it is of relative importance when assessing sales. It provides a greater indication of the determinants of wages at the worker level. Although oil matters, the largest contributor to inequality is size, while other factors, such as foreign exposure, labour union and age, play a secondary role.

Table 38: Contribution of the Different Factors using Average Wage as a Dependent Variable

	Model 1: sales	Model 2: sales per worker	Model 3: employment
oil_dummy	27.24%	44.06%	5.97%
Fexposure	0.82%	15.10%	0.24%
Permlshr	0.27%	3.12%	4.13%
Labunion	0.06%	0.34%	0.00%
Age	0.93%	5.51%	0.02%
age^2	0.00%	0.00%	0.00%

source: Author's estimations

Chart 33: Decomposition of Wage Inequality

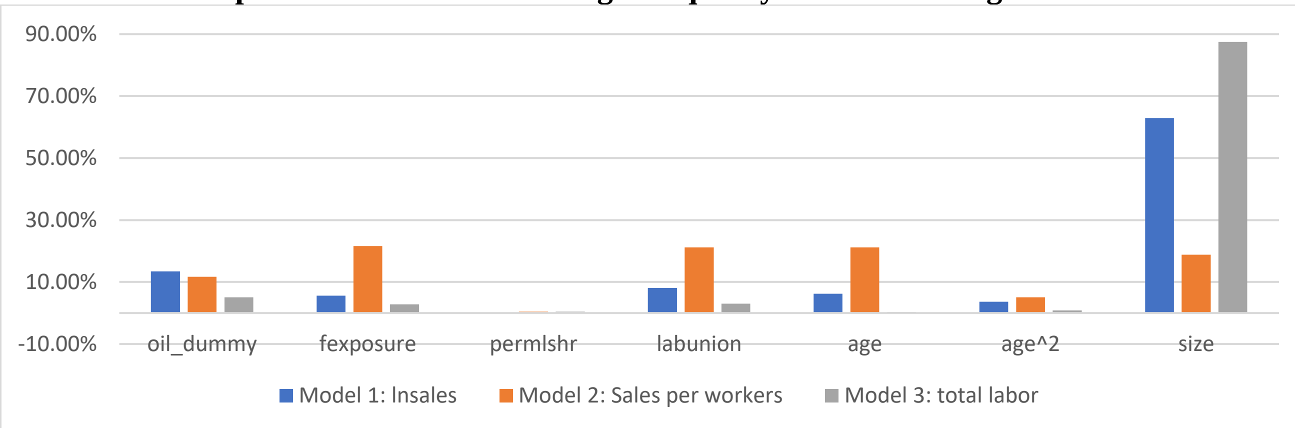


source: Author's estimations

5.6.4.2.1 Inequality among Manufacturing Firms

Inequality among manufacturing firms is also mainly explained by size. Oil plays a significant role and explains between 5 and 13 % of the total wage inequalities in Nigerian firms. However, among manufacturing firms (as discussed above), foreign exposure, labour unions and age play a greater role in explaining observed inequalities, as illustrated in Chart 34 below.

Chart 34: Decomposition of Firm-Level Wage Inequality: Manufacturing Firms

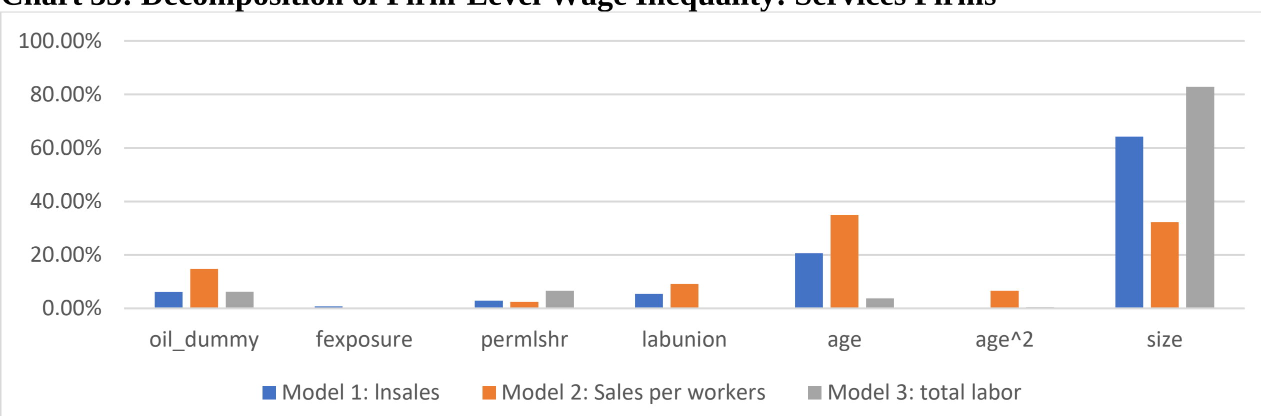


source: Author's estimations

5.6.4.2.2 Inequality among Services Firms

Similarly, among firms operating in the services sector, size matters and plays a similar role in explaining wage inequalities (Chart 35). Oil plays a significant but lesser role when compared to manufacturing firms. While the labour union measurement explains, at best, 10% of inequality, it represents at least 5% of inequality for manufacturing firms. Finally, age explains more of the inequalities among services firms when compared to manufacturing firms.

Chart 35: Decomposition of Firm-Level Wage Inequality: Services Firms



source: Author's estimations

5.7 Discussions

This chapter aims to investigate the decomposition of wage inequalities in Nigeria by applying a methodology developed initially by Wagstaff, et al. (2001) to study inequalities in the country. As far as is known, this analysis is the first to provide evidence on drivers of wage inequality in Nigeria, and the role played by oil in determining inequality. Using total wage and wage per worker at the firm level as dependent variables, this chapter has provided new evidence on disparities among firms in the context of an oil-rich country, where resource extraction is mainly concentrated in one geopolitical region. In addition, this region receives relatively large shares of revenue through the country's revenue-sharing formula.

This chapter shows that firms in oil-rich regions are more likely to pay a premium on wages. In Nigeria, the assumed wage determinants indicate that firms' location in an oil-producing region impacts wages positively and contributes to wage inequality across firms. The methodology entails combining the marginal effect of the different explanatory variables on wages. This effect captures the fact that a determinant is more prevalent among firms offering a relatively small average wage or among those offering a larger average wage. For instance, part of the wage inequality is attributed to firms being located in an oil-rich state. This results in firms in oil-rich regions paying, on average, at least 10% more than firms in other parts of the country. Size (assessed by different proxies) contributes most significantly to wage inequality. Thus, larger firms will be paying larger wages, while factors such as foreign exposure, the presence of labour unions, the permanent size of employment, and the age of a firm also have positive, but more marginal, contributions to wage inequalities.

5.7.1 Impact of Oil on Wage Determination

The analysis above indicates, as suggested by Dutch Disease theory and the mechanisms presented by Brunstad and Dyrstad (1997), that oil has an impact on the local economy by affecting determinants of one of the key production inputs for firms – namely wages. The wage offered by a firm located in the oil-producing geopolitical region of a country like Nigeria is impacted by the inflows of oil revenue at the subnational level. Those results hold for different measures of wages and across the full sample and across sectors. Furthermore, these results hold for when actual revenue received by oil-rich states from the federal government (in line with the country's revenue sharing formula) are used as explanatory variables. The abundance of oil at the local level also feeds wage inequality in the country. This analysis provides evidence of another mechanism through which this region of Nigeria is affected by the abundance of oil, i.e. higher wage levels affecting the overall competitiveness of firms.

This effect is found across firms, sectors and even across firms that are assumed to be of similar productivity levels, given their ability to export. Indeed, even among firms facing external markets, it was found that firms in the South-South region are paying a premium on wages. Further, when looking at the difference across sectors, it becomes clear that the interaction term between the oil dummy and foreign exposure matters. Thus, both manufacturing and service sectors in those regions could be more cost-competitive if this premium did not exist. Indeed, in the service sector, we find that firms exposed to international markets have to pay lower wages to remain competitive. This points to the structure and the nature of non-tradable goods, which allow firms to pay higher wages because they face very little external competition. Within the manufacturing sector, exporting for an assumed similar level of productivity, firms in the South-South region pay workers up to 55 % more. This suggests that these firms could be relatively more competitive if this premium did not exist. This premium could be explained by several factors, all linked directly and indirectly to the abundance of resources at the local level.

First, efficiency wage and rent-sharing theory could explain these results. The efficiency wage hypothesis suggests that firms offering higher wages or increasing wages could, in effect, reduce costs, as it may result in the increased productivity of workers. For similar reasons, the rent-sharing theory or gift exchange theory (Akerlof, 1982, 1984) argues that firms, by offering higher wages, can promote workers' loyalty and this can result in increased productivity. The strength of this effect will determine the extent to which firms are willing to share profits. By extension, this bargaining can result from the threats that workers have the power to reduce profit to zero (Azam and Ris, 2001). This could be facilitated by the fact that government revenue is higher due to the Nigerian revenue sharing formula and, thus, increased local demand puts pressure on the price of goods and services, thus pushing wages upwards.

Aigbokhan (2011) finds evidence of both these effects in Nigeria, which are likely to be exacerbated in the oil-rich region, as firms with limited labour mobility in the country have to increase wages to retain and attract skilled workers. The region is also negatively affected by the effects of pollution on human health, and this has an impact on labour supply and productivity. Thus, paying higher wages could be one mechanism through which firms seek to maintain productivity and mitigate against the impact of oil (see Agbonifo, 2016; Ordinioha and Brisibe, 2013).

This evidence and the negative externalities associated with oil exploitation present a strong case for the government to develop revenue-sharing mechanisms. However, the impact of these mechanisms is mixed. This analysis indicates that oil impacts the wage determination process, thus presenting a possible impact of such a policy affecting private sector activities through lower international competitiveness, as well as an impact on government in terms of revenue generation (states within that region rely less on taxes as a source of income, also pointing to little incentive to foster a private-sector-friendly environment).

This argument is in line with the literature, as revenue sharing formulas may show some limitations in improving local living conditions. Indeed, Aragon and Rud (2013), in the case of Peru, doubt the ability of revenue sharing mechanisms as policy instruments to redistribute resource wealth at the subnational level. Similarly, Loayza et al. (2013), still in the case of resource exploitation at the subnational level in Peru, found that resource exploitation positively impacts socioeconomic outcomes such as poverty rates and consumption, but this impact is not as clear when government transfers are considered, underlining issues related to the quality of expenditure. In line with these studies, Woller et al. (1998), using panel data, fail to establish a clear relationship between fiscal decentralisation and economic growth in developing countries.

In the Nigerian context, given the fiscal federalism model, states in the resource-rich region should consider using savings tools, such as sub-national resource funds, which will help them smooth out the impact of oil resources, as well as support efforts to control the wage premium potentially driven by local costs of living.

5.7.2 Discussions around observed wage inequalities

A mechanism such as the one described above will help reduce wage inequality. Nevertheless, the main source of firm inequality is size. This can be perceived as larger firms being at the root of wage inequality and/or smaller firms not keeping up in terms of efficiency and, thus, also failing to keep up in terms of wages offered. Larger firms may be paying wages that do not reflect productivity levels – reinforcing the Dutch Disease and rent-sharing hypotheses. This could result from the higher probability of larger firms obtaining government contracts or better access to public goods, for example. This also calls for further study of the link between public-sector employment and wage determination in that sector, as well as its impact on the private sector. If wages are indexed on public sector wages (which are driven by oil revenue spending, as presented in Chapter 3), this may artificially push up wages, in turn contributing to wage inequality.

At the same time, wage growth remains sluggish in smaller firms, contributing to the inequality of wages in Nigeria. These firms are less likely to be able to manage the difficulties of the business environment, which negatively affects their growth and, therefore, the wages they pay. Designing effective mechanisms to boost productivity for small and medium-sized enterprises will, therefore, be critical in raising wages and reducing wage inequalities in Nigeria. These types of policies could be complementary to the implementation of a minimum wage to raise workers' incomes in small firms; thus, a gain of productivity will increase wages, while the minimum wage measure will support a reduction in wage inequality. As indicated in Chapter 3, wages in Nigeria (and in several sub-Saharan African countries) do not reflect productivity levels; further increasing wages without productivity-related measures will prevent firms from ever being competitive, internationally.

In addition, a number of other issues would require further research. These include the role of labour mobility in the Nigerian context. Greater mobility could help control the premium paid in oil-rich regions, which contributes to inequality. The role of unionised labour would also be interesting to further explore, as greater unionisation, in particular among small and medium firms, could help reduce inequality.

Finally, the difference across the manufacturing and services sector is interesting in the sense that the services sector presents the greatest inequality due to its heterogeneous nature, as well as its relative informality, which allows firms to pay lower wages. Thus, if Nigeria is to reduce poverty, (assuming this can be done through wages) and given the existing GDP structure tilt towards the services sector, more effort is needed to set standards and enforce labour laws in the country.

This section has built on the previous chapter by assessing the fact that the exchange-rate policy undertaken by oil-driven revenue inflows has had an impact on the employment level in the manufacturing sector. In the next chapter, how a shock may well impact several variables, including wages in case of a dual labour market (formal and informal), will be assessed. The way in which a saving fund, i.e. the Sovereign Wealth Fund (as recommended at the sub-regional level), could help smooth out the wage premium paid by firms in resource-rich regions and could thus mitigate the impact of resource distribution on wages will be considered.

5.8 Annexe

5.8.1 Descriptive Statistics

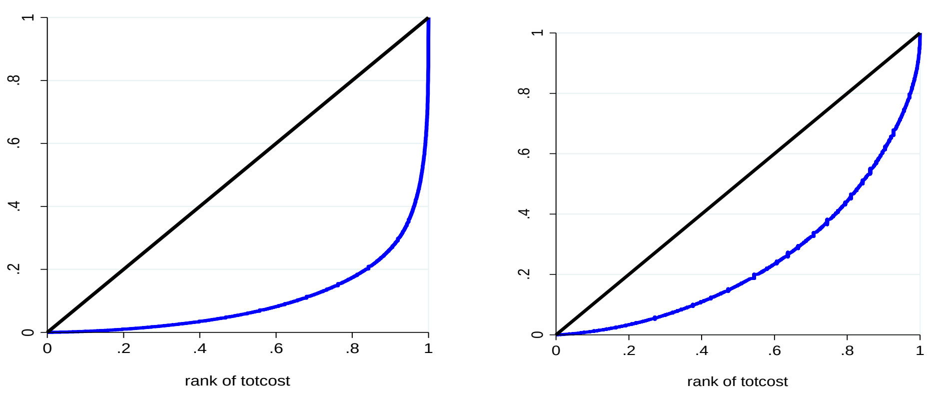
Variable	Size	Oil	Obs.	Mean	Std.	Min	Max
Total cost	Small	no	3019	1,696,773	3,748,441	18000	160,000,000
		Yes	424	1,979,841	2,481,618	80,000	23,000,000
	Medium	no	928	8,901,763	11,100,000	250,000	120,000,000
		Yes	269	8,471,039	13,200,000	180,000	122,000,000
	Large	no	116	123,000,000	307,000,000	1,824,000	2,290,000,000
		Yes	32	112,000,000	175,000,000	6,500,000	840,000,000
	Total	no	4063	6,808,166	55,800,000	50,000	2,290,000,000
		Yes	725	9,240,933	43,300,000	80,000	840,000,000
Average cost	Small	no	3019	145,120	158,162	4,816	4,333,334
		Yes	424	162,200	158,531	3,890	1,636,364
	Medium	no	928	217,156	187,277	10,588	2,666,667
		Yes	269	213,974	252,596	3,462	3,297,297
	Large	no	116	418,131	388,727	41,841	2,662,722
		Yes	32	449,452	480,966	47,027	2,288,828
	Total	no	4063	169,368	183,286	4,816	4,333,334
		Yes	725	194,088	227,665	3,462	3,297,297
# of employers (perm)	Small	no	4483	10	15	1	19
		Yes	610	7	5	1	19
	Medium	no	1577	32	24	20	99
		Yes	332	32	18	20	99
	Large	no	310	279	620	100	5,000
		Yes	40	255	466	100	2,860
	Total	no	6370	29	149	1	5,000
		Yes	982	27	105	1	2,860
# of employers (temp)	Small	no	4386	1	6	0	560
		Yes	606	1	3	0	30
	Medium	no	1531	4	10	0	120
		Yes	334	4	9	0	70
	Large	no	285	26	109	0	1,000
		Yes	37	28	99	0	600
	Total	no	6202	3	26	0	1,000
		Yes	977	3	20	0	600
Sales	Small	no	4219	232,800,000	7,398,500,000	15,000	673,000,000,000
		Yes	592	282,150,000	5,926,000,000	38,000	275,000,000,000
	Medium	no	1468	525,000,000	9,190,000,000	21,000	275,000,000,000
		Yes	327	106,000,000	407,000,000	60,000	4,680,000,000
	Large	no	293	8,460,000,000	63,400,000,000	50,000	1,000,000,000,000
		Yes	38	8,340,000,000	43,500,000,000	250,000	269,000,000,000
	Total	no	5980	834,000,000	19,000,000,000	15,000	1,000,000,000,000
		Yes	957	676,000,000	12,400,000,000	38,000	275,000,000,000
PW sales	Small	no	4101	15,883,002	525,750,000	400	61,200,000,000
		Yes	565	56,903,824	1,200,500,000	2,714	55,000,000,000
	Medium	no	1422	8,794,152	122,000,000	577	2,960,000,000
		Yes	317	3,275,561	19,500,000	1,714	333,000,000
	Large	no	251	10,100,000	39,500,000	375	459,000,000
		Yes	37	68,700,000	384,000,000	174	2,340,000,000
	Total	no	5774	19,800,000	839,000,000	375	61,200,000,000
		Yes	919	66,500,000	1,820,000,000	174	55,000,000,000
Age	Small	no	4380	14	10	0	105
		Yes	612	12	8	1	102
	Medium	no	1536	15	11	0	84

5.8.2 Wage decomposition using the total wage bill as a dependent variable

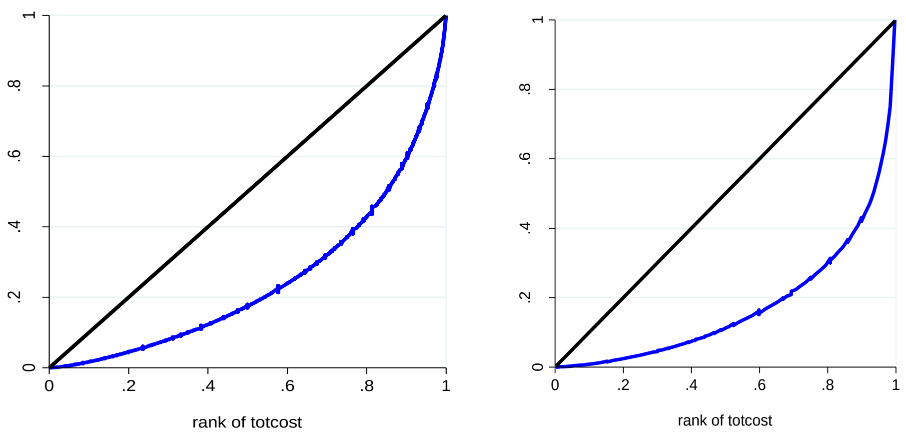
Gini coefficient – Total wage bill

	Manufacturing	Full sample	Service
Total	0.8129	0.7961	0.7805
Small (5-19)	0.4687	0.5170	0.5768
Medium (20-99)	0.5090	0.5095	0.4972
Large (100+)	0.6867	0.6572	0.4810

Gini index based on total wage costs (full sample lhs and small firms rhs)



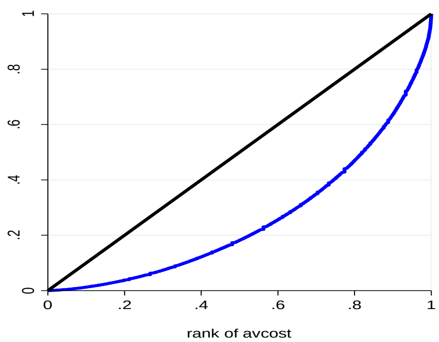
Gini index based on total wage costs for medium firms and large firms

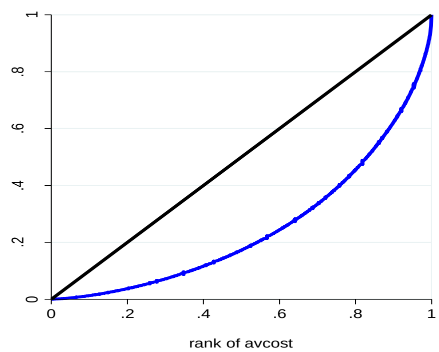


5.8.3 Wage decomposition service sector

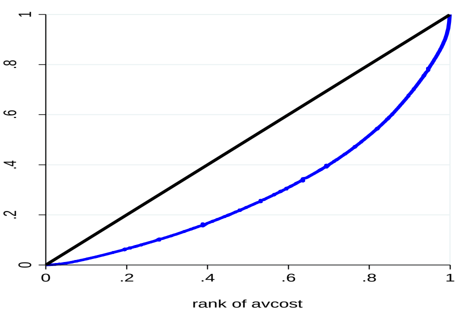
Lorenz curve on average wage cost per worker – **Service firms**

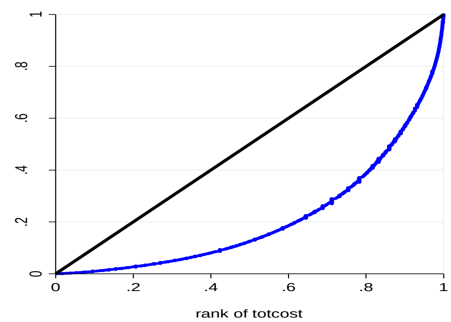
Full sample and small firm for **average wage per worker**



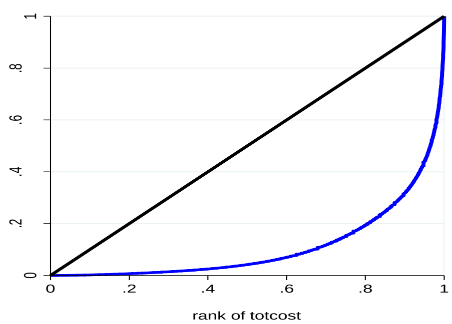


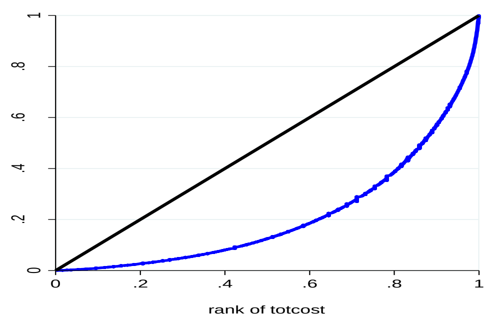
Medium and large firms **for average wage cost per worker**



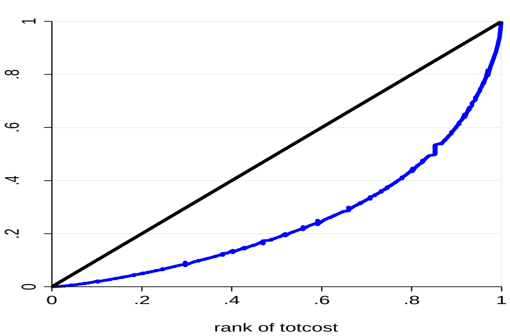


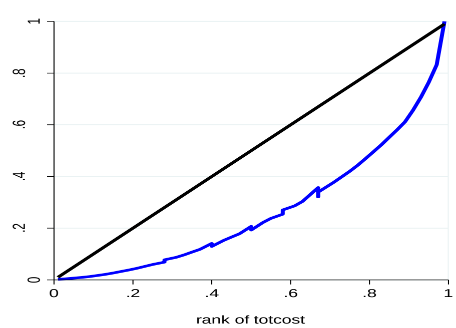
Full sample and small firm for **total wage bill**





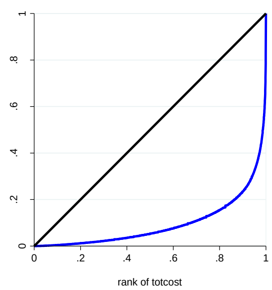
Medium and large firms **for total wage bill**

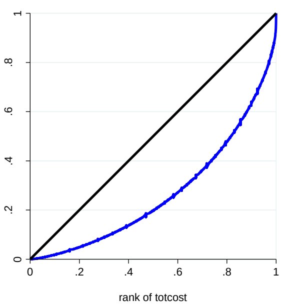




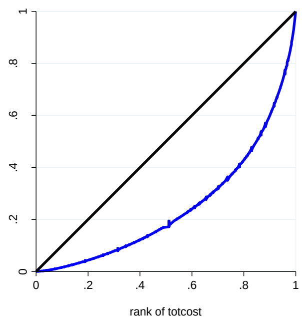
5.8.4 Wage decomposition – Manufacturing firms

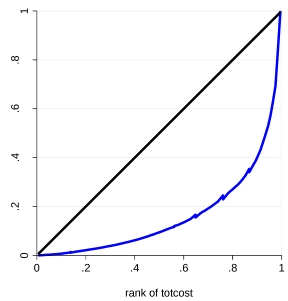
Full sample and small firm for total wage bill



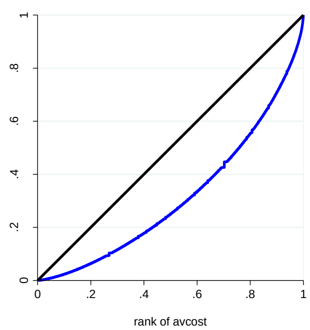


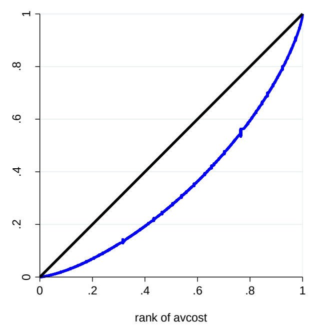
Medium and large firms for average and total wage cost



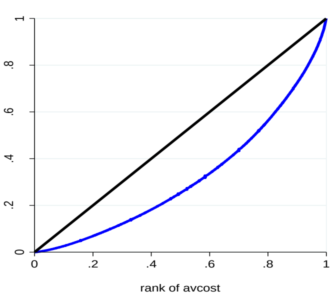


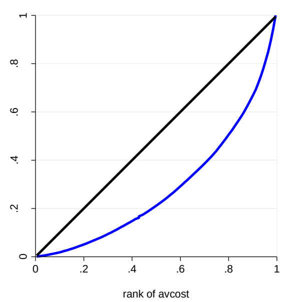
Full sample and small firm for average wage per worker





Medium and large firms for average wage cost per worker





5.8.5 Wage decomposition – Detailed Computation

Model 1 - Dependent variable is ln (Total wage cost)

Variable	Marginal effects	Ck.	Contribution to CI	Contr. %	Contr. % pc
Age	0.0693897	0.4714097	0.032710978	14.55%	14.55%
age^2	-0.009065	1.034838	-0.009380806	-4.17%	-4.17%
fexposure	0.0025609	2.812975	0.007203748	3.20%	3.20%
Labunion	0.0156194	1.101927	0.017211439	7.65%	7.65%
oil_dummy	0.0411677	0.6188037	0.025474725	11.33%	11.33%
Permlshr	0.1008436	0.02110543	0.002128348	0.95%	0.95%
log(sales)	0.6847157	0.2183522	0.149509179	66.49%	66.49%
Model 2 - Dependent variable is ln(Total wage cost)					
Age	0.2351895	0.4714097	0.110870612	37.12%	37.12%
age^2	-0.0213979	1.034838	-0.02214336	-7.41%	-7.41%
fexposure	0.0152574	2.812975	0.042918685	14.37%	14.37%
Labunion	0.0515317	1.101927	0.056784172	19.01%	19.01%
oil_dummy	0.0727739	0.6188037	0.045032759	15.08%	15.08%
Permlshr	-0.4758641	0.02110543	-0.010043316	-3.36%	-3.36%
log(pw_sales)	0.5837592	0.1289419	0.07527102	25.20%	25.20%
Model 3 - Dependent variable is ln(Total wage cost)					
Age	0.0389948	0.4714097	0.018382527	1.98%	1.98%
age^2	0.00506	1.034838	0.00523628	0.57%	0.57%
fexposure	0.0052248	2.812975	0.014697232	1.59%	1.59%
Labunion	0.0108535	1.101927	0.011959765	1.29%	1.29%
oil_dummy	0.0734046	0.6188037	0.045423038	4.90%	4.90%
Permlshr	1.500115	0.02110543	0.031660572	3.42%	3.42%
log(nemp)	1.195932	0.6681735	0.79909007	86.25%	86.25%
Model 4 - Dependent variable is ln(Total wage cost)					
Age	0.1577432	0.4714097	0.074361675	2.21%	2.21%
age^2	-0.0098847	1.034838	-0.010229063	-0.30%	-0.30%
fexposure	0.0113476	2.812975	0.031920515	0.95%	0.95%
Labunion	0.0372993	1.101927	0.041101106	1.22%	1.22%
oil_dummy	0.0695759	0.6188037	0.043053824	1.28%	1.28%
Permlshr	0.0812111	0.02110543	0.001713995	0.05%	0.05%
medium firms	1.346087	0.7193837	0.968353047	28.81%	94.59%
large firms	3.073796	0.7193837	2.21123874	65.78%	
Model 5 - Dependent variable is ln(Average wage cost)					
Age	-0.0304181	0.3671347	-0.01116754	-5.29%	-5.29%
age^2	0.0054257	0.780272	0.004233522	2.01%	2.01%
fexposure	-0.0021091	2.328077	-0.004910147	-2.33%	-2.33%
Labunion	-0.0049164	0.6547699	-0.003219111	-1.53%	-1.53%
oil_dummy	0.0447939	0.2658983	0.011910622	5.64%	5.64%

Permlshr	1.218483	0.1301507	0.158586415	75.13%	75.13%
log(sales)	0.3266292	0.1703608	0.055644812	26.36%	26.36%
Model 6 - Dependent variable is ln(Average wage cost)					
Age	0.0253493	0.3671347	0.009306608	4.89%	4.89%
age^2	-0.0016854	0.780272	-0.00131507	-0.69%	-0.69%
fexposure	0.0009149	2.328077	0.002129958	1.12%	1.12%
Labunion	0.0067089	0.6547699	0.004392786	2.31%	2.31%
oil_dummy	0.0459269	0.2658983	0.012211885	6.42%	6.42%
Permlshr	0.701457	0.1301507	0.09129512	47.96%	47.96%
log(pw_sales)	0.4682937	0.1544396	0.072323092	38.00%	38.00%
Model 7 - Dependent variable is ln(Average wage cost)					
Age	0.0389948	0.3671347	0.014316344	4.75%	4.75%
age^2	0.00506	0.780272	0.003948176	1.31%	1.31%
fexposure	0.0052248	2.328077	0.012163737	4.04%	4.04%
Labunion	0.0108535	0.6547699	0.007106545	2.36%	2.36%
oil_dummy	0.0734046	0.2658983	0.019518158	6.48%	6.48%
Permlshr	1.500115	0.1301507	0.195241017	64.79%	64.79%
log(nemp)	0.1959321	0.2504599	0.049073134	16.28%	16.28%
Model 8 - Dependent variable is ln(Average wage cost)					
Age	0.0585422	0.3671347	0.021492873	0.32%	0.32%
age^2	0.0023266	0.780272	0.001815381	0.03%	0.03%
fexposure	0.0061321	2.328077	0.014276001	0.21%	0.21%
Labunion	0.0150052	4.788	0.071844898	1.06%	1.06%
oil_dummy	0.0731837	4.788	0.350403556	5.17%	5.17%
Permlshr	1.268302	4.788	6.072629976	89.68%	89.68%
medium firms	0.2116483	0.3234356	0.068454595	1.01%	3.53%
large firms	0.5267266	0.3234356	0.170362134	2.52%	

5.8.5.1 Summary for the whole sample

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8
oil_dummy	27.24%	44.06%	5.97%	4.14%	2.82%	0.27%	1.65%	0.32%
fexposure	0.82%	15.10%	0.24%	0.86%	0.00%	0.00%	0.01%	0.00%
Permlshr	0.27%	3.12%	4.13%	0.01%	13.83%	1.09%	6.33%	1.84%
Labunion	0.06%	0.34%	0.00%	0.02%	0.00%	0.00%	0.00%	0.00%
Age	0.93%	5.51%	0.02%	0.25%	2.91%	0.68%	3.91%	18.89%
age^2	0.00%	0.00%	0.00%	0.00%	7.77%	0.63%	3.35%	1.71%
Size	70.68%	31.87%	89.64%	94.72%	72.66%	97.33%	84.75%	77.23%

5.8.5.2 Summary for manufacturing firms

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8
oil_dummy	13.42%	11.68%	5.05%	1.19%	6.71%	8.21%	6.81%	4.45%
fexposure	5.57%	21.63%	2.80%	1.63%	0.68%	3.62%	6.88%	4.86%
Permlshr	0.10%	0.44%	0.40%	0.01%	66.96%	50.54%	63.73%	35.20%
Labunion	8.07%	21.22%	3.08%	1.90%	1.29%	5.55%	7.04%	5.21%
Age	6.21%	21.21%	0.33%	1.31%	5.35%	0.42%	0.85%	1.51%
age^2	3.69%	5.05%	0.89%	0.13%	1.93%	0.23%	2.17%	0.99%
Size	62.93%	18.79%	87.44%	93.83%	17.07%	31.44%	12.51%	47.78%

5.8.5.3 Summary for services firms

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8
oil_dummy	6.08%	14.72%	6.25%	2.17%	4.95%	9.85%	32.92%	24.89%
fexposure	0.70%	0.09%	0.01%	3.04%	1.14%	0.98%	0.06%	0.13%
permlshr	2.95%	2.40%	6.62%	0.28%	26.01%	16.58%	34.87%	20.52%
labunion	5.44%	9.16%	0.12%	0.61%	5.45%	1.60%	0.61%	1.51%
age	20.56%	34.90%	3.76%	3.18%	9.52%	12.94%	19.79%	20.39%
age^2	0.06%	6.57%	0.42%	0.63%	10.70%	4.74%	2.19%	0.52%
size	64.22%	32.15%	82.82%	90.08%	42.23%	53.32%	9.56%	32.04%

Chapter 6
Oil Shocks in a Developing Resource-Rich Economy – a DSGE Approach

6.1 Introduction

Chapter 4 highlighted how government policies, such as exchange rate policy, could impact the level of employment in Nigeria and, more specifically, in the manufacturing sector. Chapter 5 further showed that oil-revenue redistribution impacts the price of labour (i.e. wages) and contributes to wage inequality among firms. This last analytical chapter will further present the possible distortionary role that oil, and its management, can play by assessing the impact of a temporary shock on resources in a resource-rich developing country modelled on Nigeria. This is achieved by considering some of the characteristics of a developing country's labour market, such as labour market fragmentation. Further, the discussions of this chapter will contribute to spending/saving decisions of oil revenues by analysing fiscal policy impact on the labour market and the economy as a whole.

Chapter 2 and 3 highlighted how natural resource revenues generate important sovereign wealth, which is used through the national Nigerian budget to finance government expenditure. However, natural resource management in developing countries is still a challenge with regards to the optimal spending and investing decisions resulting from the intrinsic nature of the resource revenue, resulting in a certain degree of volatility (see Blattman, Hwang and Williamson, 2007; Fatás and Mihov, 2005; Baxter and Kouparitsas, 2006; and Ramey and Ramey, 1995).

Dutch Disease and other possible adverse impacts from large revenue inflows could be the result of the inability of fiscal authorities to effectively manage political pressures - requests for higher public spending - which adds pressure on the demand for services. Indeed, as suggested by Gelb, (1988), and Sala-i-Martin et al., (2013), the saving option is often not seen as viable by politicians and, in practice, hardly ever enforced in the developing economies context.

Under these circumstances, tools at the disposal of policymakers, namely monetary and fiscal policies, can impact the reallocation of natural resource revenues. A common recommendation (as highlighted by van de Ploeg, 2011; see also Collier et al., 2010) is for governments to intervene by restricting fiscal spending during resource booms and to promote saving. To do so, conventional wisdom requires that revenue inflows are in a fund (e.g. a sovereign wealth fund) as highlighted in Collier et al. (2010). Unfortunately, in many developing countries, these funds have failed to serve their purpose as shown by the performance of these funds captured by the Natural Resource Governance Institute briefing (2018) paper on premature funds.

Within the DD framework, government policies (i.e. fiscal and monetary) that are implemented in response to the possible impact of resource revenue will impact the labour market. Exchange rate real appreciation may result in declining economic sectors and the possible loss of competitiveness. These are not necessarily a source of concern if they reflect the transition from one equilibrium to another and do not automatically require government intervention. This is argued by Corden (2012), who suggests that the most appropriate policy answer to DD is to *"do nothing"* and allow for a currency appreciation, thereby lifting real consumption and wages through lower import prices. Under this assumption, a policy intervention could take the form of a welfare-reducing policy resulting in possible underinvestment at home. However, in most cases, the possible large political cost of doing nothing in the light of the changing economic structure has encouraged government intervention.

Thus, difficulties in managing resource-revenue inflows arise at different stages. This analysis is a contribution to the rich literature on the effects of oil windfalls and natural resources on the main macroeconomic aggregates in resource-rich countries, while also integrating features of developing countries which have been overlooked. The chapter will ask the following question: How do key macroeconomic variables, including wages and employment levels, of a small open resource-rich economy respond to shocks when labour market segmentation (i.e. the formal and informal sectors) is taken into account? Further, taking into account those characteristics, the chapter investigates how a temporary windfall affects the economy under various policy options. This part of the analysis will focus on evaluating several policy options available and the choice between spending-as-you-go or creating a sovereign wealth fund (SWF). The focus will be on assessing the impact of these policy rules by taking into account some of the key features of developing countries.

6.2 Approach

In order to provide an analysis accounting for the multifaceted dimensions of both government intervention and the developments of the labour market, a dynamic stochastic general equilibrium (DGSE) modelling approach will be employed. Although the implications could be applicable to many developing resource-rich countries, the model used here is calibrated to match the Nigerian data, which is a prime example illustrating the impact of oil-revenue inflows, as underlined by Gelb (1988) and Sala-i-Martin et al. (2013).

DSGE modelling allows for the derivation of macroeconomic variables using microeconomic relationships between relevant agents, as well as the incorporation of their intertemporal choices (in response to Lucas' critique (1976)). These models are dynamic as they allow for agents to make current choices while internalising uncertain future outcomes; thus, the expectations of rational agents play a crucial role in impacting the economy. In addition, the general equilibrium aspect underlines the role that policies can have on an agent's behaviour. In addition, these models allow for the inclusion of shocks which can be traced through the modelled economy specifications. Given these characteristics, the choice of a DSGE model is appropriate to assess the central question of this chapter.

A DSGE model has been created representing a small open economy borrowing features from several authors, including Medina et al. (2007), Berg et al. (2010), Beidas-Strom et al. (2011) and Benkhodja (2014), all of which include key economic characteristics common to developing economies reliant on resource-revenue inflows, such as habit formation, limited access to credit and limited factors of production (i.e. labour and capital mobility).

Another important characteristic of the model used here is the distinction between formal and informal labour markets. Developing countries' labour markets can be characterised by a significant heterogeneity in both demand and supply; however, accounting for this large heterogeneity in a DSGE model is difficult. Thus, the model developed here will assume duality in the labour market, as often reflected in development economics. This approach has also been reflected in some New Keynesian DSGE models, which are capable of capturing business cycle fluctuations for emerging economies (Batini et al. 2011; Peiris and Saxegaard 2007; Zenou 2008; Mattesini and Rossi 2010; and Castillo and Montoro 2008).

Within the existing literature, the model presented in this chapter is closest to the one developed by Conesa et al. (2002) and Ahmed (2002), with an informal goods-producing sector using differentiated technology and an informal labour market. Conesa et al. (2002) included the informal producing sector in a Real Business Cycle type of model. In this model, sector trade-off is allowed through the presence of a formal sector wage premium. Furthermore, labour is assumed to be indivisible in the formal sector. Households are assigned a probability of working in one of the two sectors. An informal sector worker is expected to enjoy more leisure at the cost of reduced wages.

In line with this argument, Ahmed (2012) introduced informality in the productive sector, assuming differentiated technology and an informal labour market in a simple RBC model. However, in this model, the same household has the possibility of working for either sector, rather than assuming that households are assigned a sector with a set probability. Households are differentiated based on skills, which are only recognised through a markup/premium on a wage they can charge by working in the formal sector. In this way, Ahmed (2012) obtained a segmented labour market analysis that showed that households choose between the number of hours they wish to supply to each of the two sectors that maximise their utilities. In this paper's model, as in Conesa's (2012), households are differentiated based on skills, but are assigned a sector (formal or informal). Thus, a segmented labour market is created with households being unable to choose the ir preferred sector, only being able to decide on the working hours to supply to formal and informal sectors to maximise their overall utility.

However, unlike Conesa and Ahmed, who present a simple RBC model, this framework is based on an open economy. This restriction was addressed in the literature by Senbeta (2013), who investigated labour market segmentation through a DSGE model representing a developing open economy. Although Senbeta's paper relaxes the open economy assumption, it does not include features such as financial market frictions and capital accumulation, which are important in the developing country context. This will be addressed by adopting features proposed by Medina and Soto (2005), with differentiated access to credit and to capital.

Another specific characteristic of the model used here refers to the integration of real frictions in terms of wages and price**.** In line with Soto and Medina (2005), themselves inspired by, among others, Smets et al. (2003, 2007) and Christiano et al. (2005), a DSGE model with nominal and real frictions in terms of wages and price but also incorporating formal and informal households and consumption is presented, designed to capture the main features of a resource-rich developing country such as Nigeria.

The assumption of sticky prices, as suggested by Blanchard et al., (2005), means that expressions of marginal costs will depend on both the variations of output and the gap between real and equilibrium real wages. Under this assumption, a shock that affects the equilibrium real wage also impacts price inflation as real wages may not automatically adjust to the equilibrium level. This implies that to resolve the disequilibrium, output needs to be adjusted. Thus, with assumed wage and price stickiness, policymakers face a trade-off between price and outputs. This mechanism is endogenous to the model, as in Erceg, et al. (2000).

Further, a sticky-wage assumption has a welfare implication as households face changes in the labour they supply because the marginal utility of labour is decreasing. Thus, in addition to internalising changes in output and inflation, the policymaker has to take into account wage inflation, which impacts the employment level (in this case the number of hours worked). Wage and price stickiness are particularly interesting in terms of investigating the question of interest which assesses the effect of an oil shock on wages and employment levels as a shock is expected to affect the output level, price inflation and wage inflation of a developing country such as Nigeria.

A third factor of importance in this model is the oil sector and its impact on the economy. The model here assumes that the oil sector is exogenous, in line with the assumption that the resource sector in many developing countries operates as a capital-intensive enclave that creates limited employment (Karl, 1997). However, to reflect the specificity of the case study, the assumptions made by Medina and Soto (2005) and Bouakez et al. (2008), who posit that oil is produced and consumed locally, are disregarded. In this case, it is assumed that all oil production is exported and then re-imported for domestic consumption, and thus plays a marginal role as an input of production. This reflects the fact that ongoing electricity production issues imply that developing countries rely on alternative sources of energy production, such as generators running on diesel, while industrial production firms depend on their own source of energy production. Thus, oil shocks will play an indirect role by impacting the formal firms’ activities through their access to public goods (financed by the government) and formal households through the share of oil revenue.

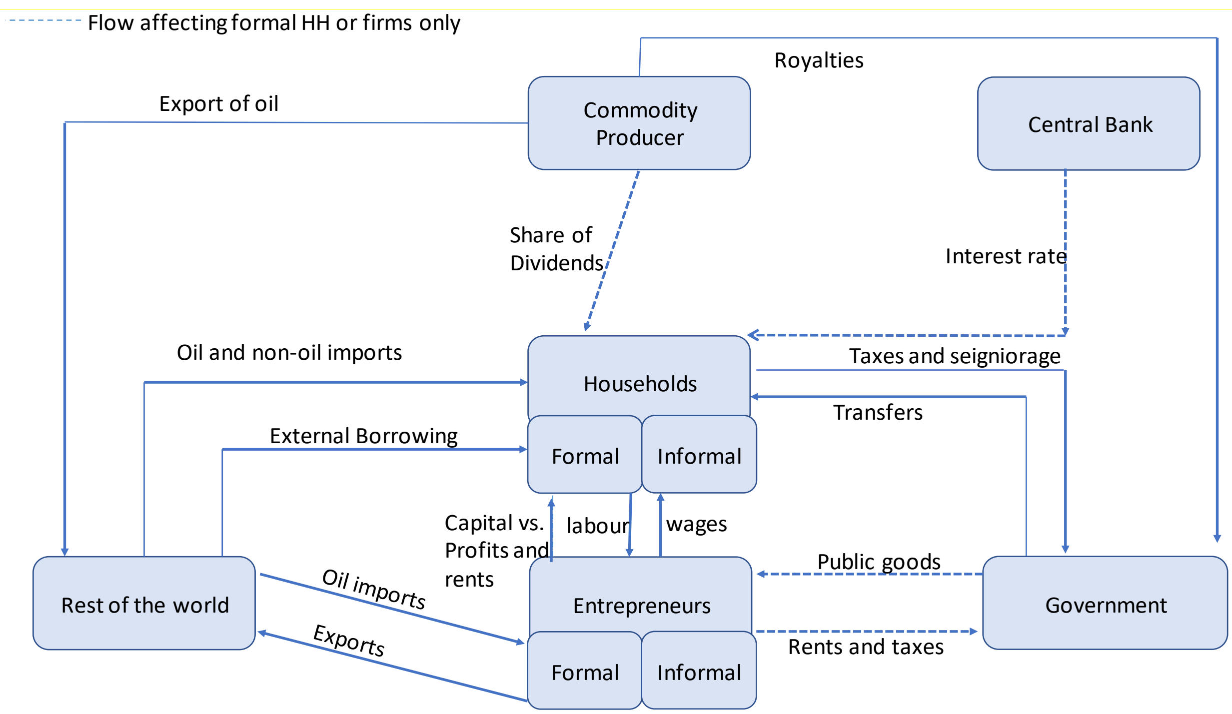
Thus, within this theoretical setting, an oil-price shock will impact income which, in turn, will affect consumption and labour decisions. It will also indirectly impact firms' marginal costs of labour. Similarly, the capital level and marginal cost of capital will be affected by government-provided public goods, thereby affecting their pricing decisions.

Finally, the last aspect that will be considered in this model is the role of fiscal policy. The effect of several policy recommendations often suggested to developing countries will be presented. These include the "Bird in Hand Hypothesis" (BIH) that suggests saving resource-revenue inflows in a Sovereign Wealth Fund (SWF) and only spending the interest accumulated on those revenues, as suggested by Bjerkholt, (2002) and Barnett et al. (2003). This policy is often considered very conservative as it is a practical implementation of the Permanent Income Hypothesis (Leigh et al., 2006; Basdevant, 2008) but with the revenue not being taken into account until it has been collected. A modified Bird in Hand rule is described as a proportion of revenue being invested in capital and the rest being saved in a SWF. Both the PIH and the BIH strategies consist of transferring a significant proportion of consumption increase to future generations. This approach may be relevant for developed countries, but it is subject to debate in the developing country context given capital scarcity, infrastructure gaps and low current incomes. Those policies may prevent rapid growth and possible convergence. In this model, spending-as-you-go and other fiscal policies are analysed.

6.3 A Small Open Economy Model

The foundation of the model developed in this analysis is a small domestic economy open to trade. These assumptions imply that prices of international goods, as well as foreign interest rates and demand, are not impacted by development in the domestic economy. In addition, domestic prices (i.e. prices of goods and labour) are sticky, meaning that they are not frequently adjusted; when they can be adjusted to reflect economic conditions, prices are partially indexed to past inflation. This rigidity matters as it improves the realism of the model and, as suggested by Erceg et al. (2000) and Blanchard et al. (2005), it ensures an adequate trade-off between inflation and output fluctuations. Gradual wage adjustment and price rigidities better represent the actual macroeconomic dynamics of a small oil-exporting economy, as is the case here.

6.3.1 Details of the model



The modelled economy is composed of different types of firms:

- One set of firms are considered formal sector firms that produce differentiated intermediate tradable goods. These firms' production process requires inputs such as labour, capital and government public goods. As they act as monopolies over the goods they produce, prices can be gradually adjusted and these goods are sold to assemblers that aggregate the intermediate goods for both the domestic and international markets. For simplicity, these assemblers have no market power and they aggregate goods at no cost.
- Similarly, another set of firms are assumed to be firms operating in the informal sector that produce differentiated non-tradable intermediate goods or services. These firms only use labour in the production process and they also have a monopoly over their goods, thus they can set prices. Similar to the formal goods, these firms sell their goods to assemblers that

mainly sell to the domestic market; nevertheless, for increasing realism, a small proportion of production is assumed to be exported to reflect the complexity and diversity of the informal sector in a developing country.

- The term *importing firms* refers to the set of firms which can buy homogeneous foreign goods in the world market and use similar branding technology to convert the foreign goods into identical final imported products, which are then sold locally.
- Finally, there is a unique firm that produces the country's main commodity, which is exported. The firm cannot affect the international price of this commodity. This firm is partly owned by the government and private investors (mostly foreign, with a small proportion of domestic investors). The sector is also heavily taxed. The total stock of resources is exogenously fixed.

Two types of households are considered: Ricardian households, which can maximise their utility by inter-temporally choosing future consumption and savings. These households are assumed to supply their labour to the formal sector. The second type of household is described as non-Ricardian as they cannot save and spend all their income earned from their labour in every given period. These households are assumed to operate in the informal sector. This model assumes that the fraction (1-λ) of households represents the number of Ricardian households. These two sets of households also display habit-formation in consumption in line with the framework provided by Medina and Soto (2007), implying that next period consumption is indexed on the current period of consumption. Also, independently of the type of households, they all consume three types of goods: formal, informal and imported. These goods are an imperfect substitute in the consumption basket.

It is also assumed that the labour force is divided into two sectors: non-Ricardian households work in the informal sector to produce informal goods (services) and Ricardian households work in the formal sector to produce formal goods. There is no substitutability in the labour force; that is, households cannot move from one sector to another. For the purpose of this analysis, it is assumed that the current structure of the Nigerian economy and labour market is at equilibrium and temporal deviation from this equilibrium is assessed. This implies that the shares of the labour force in the formal and informal sectors are given and fixed; thus, households can only choose the number of hours/intensity at which they wish to work. This assumption reflects empirical evidence of little movement between the formal (La Porta and Shleifer 2008, Nataraj,

2011) and the informal sector, which has been described as being the "new normal" (Stuart et al. 2018; Jütting 2009; Chen 2012).

In accordance with existing literature (Bargain et al., 2009), it is assumed that the differentiated labour supply is provided by households and remunerated by the corresponding wage. The different households have a monopolistic power over the supplied labour. Under the wage-stickiness assumption, in each period only a (constant) fraction of households/labour types can request and obtain an adjustment to their nominal wage. Thus, aggregate nominal wage in any period does not reflect the economic condition; it only adjusts slowly to shocks. This slow adjustment and the possible wage inflation resulting from a shock results in wage distortions and a possible inefficient distribution of labour. This assumption can also be interpreted as all households/workers that specialise in a given labour service are represented by a trade union, with the latter setting the wage on behalf of its members. Another assumption underlying the model is the fact that the formal sector's productivity is higher than the informal sector's; thus, there is a wage premium to workers in the formal sector. Furthermore, Ricardian households own the different firms producing formal home goods; thus, they receive these firms' monopolistic rents.

In this model, productivity is subjected to stochastic shocks, as is standard in DSGE models. Monetary policy is mainly based on the choice of interest rates, and this decision reflects a Taylor-type rule incorporating interest rate inertia as it reacts to its own lagged value as well as inflation and GDP growth. It is also assumed that given imperfect asset substitution and the crawling exchange rate regime, the central bank can also independently affect independent monetary policy

The baseline fiscal policy assumes that the government spends revenue as it receives it, while avoiding long-term debt. Under the alternative, it is assumed that government can save part of the revenue and build reserves. Under the Bird in Hand theory, it will save the use of the interest rates for domestic spending; under the modified Bird in Hand, it will use a proportion of revenue for domestic spending, and under the last option, it will utilise part of the revenue to target the output gap.

6.3.2 Domestic Households

The modelled economy is characterised by a continuum of heterogeneous households. These households are indexed by j ∈ [0, 1], and the expected present value of their utility is as follows:

$$\boldsymbol{U = ln\left(C_t(j) - h\left(1 + g_y\right) C_{t-1}(j)\right) + \frac{\alpha}{1-\mu}\left(\frac{M_t(j)}{P_t}\right)^{1-\mu} - \frac{\zeta_t}{1+\sigma_L} Lab_t(j)^{1+\sigma_L}} \qquad \textbf{(1)}$$

where $Lab_t(j)$ is labour effort, $C_t\ (j)$ corresponds to total consumption, and $M_t\ (j)$ represents the household's end of previous period total nominal balances carried into period t. $\boldsymbol{\mu}$ defines the semi-elasticity of money demand in response to nominal interest rates. $\boldsymbol{\alpha}$ determines the weight of nominal balances in the household's preferences, parameter σ_L represents the inverse elasticity of labour supply with respect to real wages. Productivity grows at a rate of $\boldsymbol{g_y}$ in the steady state. The parameters $\boldsymbol{h(1 + g_y)}$ capture the habit formation in consumption, where $\boldsymbol{h}$ corresponds to the habit-formation parameter. This is one of the real-friction representatives of the type of economy under study. Labour supply is affected by the preference shock captured by the parameter ζ_t. This type of shock could be driven by a technological change affecting home technology. It follows an $AR(1)$ process to be subject to i.i.d innovations.

6.3.2.1 Consumption

Independent of the status (Ricardian or non-Ricardian, as discussed below), a household's consumption basket is similar in its composition. It includes oil (fuel to run generators, for example), domestics goods (from both the formal and informal sectors), as well as imported goods. The consumption bundle of a given household is represented by:

$$\boldsymbol{C_t(j) = [\delta^{\frac{1}{n}}\left(C_{o,t}(j)\right)^{\frac{n-1}{n}} + (1-\delta)^{\frac{1}{n}}(C_{z,t}(j))^{\frac{n-1}{n}}]^{\frac{n}{n-1}}} \qquad \textbf{(2)}$$

where $\boldsymbol{C_{o,t}}$ captures oil consumed, $\boldsymbol{C_{Z,t}}$ is referred to as core consumption, including non-fuel consumption, $\boldsymbol{n}$ captures the elasticity of substitution between consumption of oil and other goods and $\boldsymbol{\delta}$ is the share of oil.

At any level of income, the different households consume a composite of home (formal and informal) goods, foreign goods and oil. These choices are made to minimise the cost of the households' consumption baskets: $\boldsymbol{P_{O,t}C_{o,t}(j) + P_{Z,t}C_{z,t}(j)}$ subject to equation (2), where $\boldsymbol{P_{O,t}}$ is the price of oil deflator and $\boldsymbol{P_{Z,t}}$ represents the core consumption deflator. Thus, the demand for each set of goods (i.e. oil and core consumption) are as follow:

$$\boldsymbol{C_{z,t}(j) = (1-\delta)\left(\frac{P_{Z,t}}{P_t}\right)^{-n} C_t(j)}\text{, and } \boldsymbol{C_{o,t}(j) = \delta\left(\frac{P_{O,t}}{P_t}\right)^{-n} C_t(j)} \quad \textbf{(3)}$$

The aggregate price level is given by $\boldsymbol{P_t = \left[\delta P_{O,t}{}^{1-n} + (1-\delta)\, P_{z,t}{}^{1-n}\right]^{\frac{1}{1-n}}}$

Core consumption

The core consumption bundle is composed of foreign and home goods demand equations that serve as a constraint on the cost function:

$$\boldsymbol{C_{z,t}(j) = [\gamma^{\frac{1}{\theta}}\left(C_{F,t}(j)\right)^{\frac{\theta-1}{\theta}} + (1-\gamma)^{\frac{1}{\theta}}(C_{H,t}(j))^{\frac{\theta-1}{\theta}}]^{\frac{\theta}{\theta-1}}} \quad \textbf{(4)}$$

$\boldsymbol{C_{z,t}}$ is the bundle of core consumption (i.e. consumption of formal and informal home goods and foreign goods), where $\boldsymbol{\theta}$ captures the elasticity of substitution between home and foreign goods in the bundle and $\boldsymbol{\gamma}$ is the weight for foreign goods. The different household optimally determines the composition of core consumption by minimising $\boldsymbol{P_{H,t}C_{H,t}(j) + P_{F,t}C_{F,t}(j)}$, subject to (3). The demand for these goods is given by:

$$\boldsymbol{C_{H,t}(j) = (1-\gamma)\frac{P_{H,t}}{P_{Z,t}}^{-\theta} Z_t(j)} \textbf{ and } \boldsymbol{C_{F,t}(j) = \gamma\frac{P_{F,t}}{P_{Z,t}}^{-\theta} C_{z,t}(j)} \quad \textbf{(5)}$$

where $P_{H,t}$ is the price index for home goods and $P_{F,t}$ corresponds to the price index for foreign goods, and $P_{Z,t}$ is the price index of the non-fuel consumption set of goods, captured by: $P_{Z,t} = \left[\gamma P_{H,t}{}^{1-\theta} + (1-\gamma)\, P_{F,t}{}^{1-\theta}\right]^{\frac{1}{1-\theta}}$

Demand for formal and informal goods

Finally, the home consumption bundle is composed of the demand for formal and informal goods, and it is given by:

$$\boldsymbol{C_{H,t}(j) = [\rho^{\frac{1}{\varphi}}\left(C_{fo,t}(j)\right)^{\frac{\varphi-1}{\varphi}} + (1-\delta)^{\frac{1}{\varphi}}(C_{Inf,t}(j))^{\frac{\varphi-1}{\varphi}}]^{\frac{\varphi}{\varphi-1}}} \quad \textbf{(6)}$$

Where $\boldsymbol{C_{fo,t}}$**,** represents formal goods consumption, and $\boldsymbol{C_{Inf,t}}$ corresponds to the informal goods. $\boldsymbol{\varphi}$ is the elasticity of substitution between formal and informal goods, while $\boldsymbol{\rho}$ reflects the weight for formal goods.

Each household minimises the cost of the domestic consumption basket, $\boldsymbol{P_{Fo,t}C_{Fo,t}(j)} +$ $\boldsymbol{P_{Inf,t}C_{Inf,t}(j)}$, subject to (6). The associated demand functions for formal and informal goods are:

$$\boldsymbol{C_{fo,t}(j) = (1-\delta)\frac{P_{fo,t}}{P_{C,t}}^{-\theta} C_{H,t}(j)} \qquad \textbf{and} \qquad \boldsymbol{C_{inf,t}(j) = \gamma\frac{P_{inf,t}}{P_{C,t}}^{-\theta} C_{H,t}(j)} \qquad \textbf{(7)}$$

where $\boldsymbol{P_{Fo,t}}$ is the price index for formal goods, while $\boldsymbol{P_{Inf,t}}$ corresponds to informal goods. The consumption-based price index (CPI) is $\boldsymbol{P_{C_{H,t}}}$, while the price index of the home-produced goods consumption is $\boldsymbol{P_{CH,t} = \left[\rho P_{Fo,t}{}^{1-\varphi} + (1-\rho)\, P_{inf,t}{}^{1-\varphi}\right]^{\frac{1}{1-\varphi}}}$

6.3.2.2 Ricardian Households' Consumption and Savings Decisions

This model includes Ricardian households, which are allowed to trade in asset markets and, therefore, smooth their consumption. It also includes non-Ricardian households, which cannot possess any assets beyond initial endowment. Thus, they are credit-constrained and only consume the product of their labour.

The model assumes that λ_c is the share of non-Ricardian households, which also corresponds with the labour supply to the formal sector. Three types of assets are available to each Ricardian household to smooth consumption intertemporally: money $\boldsymbol{M_t(j)}$, one-period non-contingent foreign bonds $\boldsymbol{B_{t,F}(j)}$, and $\boldsymbol{D_t(j)}$ is a one-period domestic-contingent-bond that pays a unit of domestic currency in a particular state. Adjustments to the portfolio are free of costs; however, a household borrowing from abroad pays a premium on such foreign bonds. This premium is necessary to obtain a well-defined steady state for the economy[10].

The **Ricardian household** has an intertemporal budget constraint, expressed as follows:

$$\frac{M_t(j)-M_{t-1}(j)}{P_t} + \frac{D_t(j)-(1-i)\,D_{t-1}(j)}{P_t} + \frac{\epsilon_t\, B_{t,F}(j)-\left(1-i_t^F\right)\Theta B_{t-1,F}(j)}{P_t} + C_t^R(j) + I_t(j) = T_t(j) +$$
$$R_t(j)K_{t-1}(j) + \pi_t(j) + (1-div)\Omega + W_{\mathrm{ft}}(j)(1-\lambda_c)Lab_t \qquad (8)$$

[10] Similar to Schmitt-Grohé and Uribe (2003), when the real rate of return on the foreign bond exceeds the subjective rate of discount, the model presents continuous positive growth. This dynamism can be eliminated by assuming that the subjective discount rate equals the (average) real interest rate.

where $\boldsymbol{i_t^{\mathrm{F}}}$ captures the return on the international bond abroad, $\boldsymbol{\epsilon_t}$ is the expression for the nominal exchange rate, $\boldsymbol{W_{ft}(j)}$ is the household's nominal wage, $\boldsymbol{Tr_t(j)}$ refers to government transfers to households. $C_t^R(j)$stands for consumption specific to Ricardian households. The term $\boldsymbol{\Theta}(\frac{\boldsymbol{\epsilon_t B_t^*}}{\boldsymbol{P_{X,t}X_t}})$ is the premium paid by domestic households for borrowing abroad, with $\boldsymbol{B_{t,F}(j)}$ being the aggregate net foreign asset position of the economy, and $\boldsymbol{P_{X,t}X_t}$ represents export nominal values. This is explained by the fact that in a steady state, the economy is projected to grow; thus, so is the country's net-asset position in the long-run. For the risk premium to be stationary, it must represent the ratio between the net-asset position and a variable growing at the same rate as the economy in steady state. In accordance with Medina and Soto (2005), exports are the variable of choice; as in a resource-rich context, they are a form of international collateral (see Caballero et al., 2001).

The model implicitly assumes the availability of state-contingent claims as they insure the households against idiosyncratic wage risk, and that households will be identical in their choice of consumption, capital accumulation, capital utilisation, and bond-holdings. They will only differ in the wages they charge and in their labour supply in the case of preferences being separable in leisure and consumption. This is in line with Erceg, et al. (2000).

Households take the premium $\boldsymbol{\Theta}(.)$ as given when assessing and choosing their optimal portfolios. It also implies that the effect on the premium driven by households changes in their own foreign asset positions (see Medina and Soto, 2007). In the steady state $\boldsymbol{\Theta}(.)$ is:

$$\boldsymbol{\Theta}\left(\frac{\boldsymbol{\epsilon B^F}}{\boldsymbol{P_X}X}\right) = \overline{\boldsymbol{\Theta}} \text{ and } \frac{\boldsymbol{\Theta}'\left(\frac{\boldsymbol{\epsilon B^F}}{\boldsymbol{P_X}X}\right)}{\boldsymbol{\Theta}\left(\frac{\boldsymbol{\epsilon B^F}}{\boldsymbol{P_X}X}\right)}\frac{\boldsymbol{\epsilon B^F}}{\boldsymbol{P_X}\mathrm{X}} = \varrho$$

Here $\boldsymbol{B}^{\mathrm{F}}$ is the net foreign asset position at steady state, and $\boldsymbol{P_X}X$ corresponds to export values at a steady state, whereas ϱ is the elasticity of the upward sloping supply of international funds.

In addition, Ricardian households, as owners of the formal sector firms, receive profits $\boldsymbol{\pi_t(j)}$, and internalise the capital investment decision. They invest $\mathrm{I}_{\boldsymbol{t}}$ in every period and receive $\mathrm{R}_{\boldsymbol{t}}\ K_{t-1}$ as a price for renting capital made available to firms in one period lag (i.e. t-1). Under this framework, the household is the owner of the firms and thus investment decisions will impact its consumption, through profits which depend on the price of labour and the rental price of capital. The capital stock accumulates following a law of motion such as:

$$K_t = I_t + (1 - \delta)K_{t-1} \tag{9}$$

Where $\boldsymbol{\delta_k}$-is depreciation, K_t is the capital stock and $\mathbf{Inv_t}$-is investments.

Further, it is assumed that the share of net dividend after tax goes to the formal sector in the form of additional income.

Ricardian households' consumption, saving and investment decisions

As indicated above, households determine their consumption and the assets they are willing to hold by maximising (1) subject to (8) and (9).

With the complete set of contingent claims, consumption is assumed to be the same for all Ricardian households; thus, the index j can be omitted. The resulting first-order conditions are used to define the following Euler equation for consumption, i.e. the optimal consumption path is given below:

$$\frac{1}{C_t^R - h(1+g_y) - C_{t-1}^R} - \beta E_t \left[\frac{1}{C_t^R - h(1+g_y) - C_{t-1}^R}\right] = \psi_t \tag{10}$$

where ψ_t is the Lagrange multiplier that can be interpreted as the shadow price of marginally relaxing the constraint on C_t^R. Thus, in the case of a non-binding constraint (i.e.$\psi_t = 0$), the Euler equation holds, and the marginal benefit of the marginal consumption interpretation is straightforward. In the event of a binding constraint, the change in utility for an additional unit of consumption is equivalent to the change reflecting a decrease in consumption in the next period plus the shadow price.

The FOC with respect to foreign bond holdings is expressed as follows:

$$\beta E_t \left[\frac{\psi_{t+1}\epsilon_{t+1}(1+i_{t+1}^F)\Theta \mathrm{P}_t}{\epsilon_t \mathrm{P}_{t+1}}\right] = \psi_t \tag{11}$$

The foreign interest rate follows an AR (1) process subject to an independent and identically distributed shock. In line with Medina and Soto, 2007, these shocks to $\boldsymbol{i_t^{\mathrm{F}}}$ reflect the foreign economy's financial factors, such as risk premium or exchange-rate arbitrage.

Capital accumulation

In the household maximisation problem, the value of capital investment is dependent on its projected future value. Considering the household's maximisation problem, we obtain the following FOC:

$$\beta E_t \left(R_{t+1}\psi_{t+1} + \zeta_{t+1}(1-\delta)\right) = \psi_t \tag{12}$$

6.3.2.3 Non-Ricardian Households' Consumption's Decisions

The non-Ricardian households are not able to optimise as they do not have access to any type of assets. This includes no shares in domestic firms. As a result, it is assumed that these households only follow a rule of thumb approach by setting nominal consumption equal to wage income minus net payment to the government:

$$\boldsymbol{C_t^{NR}(j) = W_{it}\lambda_c \mathbf{Lab}_t(j) - T_t} \tag{13}$$

where C_t^{NR} is the consumption of non-Ricardian households, W_{it} is wage paid to this type of household, while T is tax paid. A key specificity of this model is that Ricardian and non-Ricardian households determine different wages – discussed below. different productivity levels between sectors (formal and informal) are also assumed, implying that the wage in the informal sector (which operates the non-Ricardian households) is lower than the one in the formal sector.

6.3.2.4 Aggregate Labour Market

It is assumed that domestically produced goods are divided into formal and informal goods. Furthermore, the labour force consists of two parts: people working in the informal sector (λ_c) and people working in the formal sector ($1-\lambda_c$). The informal sector employers are assumed to be non-Ricardian consumers, while the formal sector employers are Ricardian workers.

A household's aggregate labour is a composite of both formal ($\mathbf{Lab_{fo,t}}$,) and informal ($\mathbf{Lab_{inf,t}}$) labour. It can be expressed as: $\mathrm{Lab_t} = A * \mathrm{lab}_{\mathrm{inf,t}}^{\lambda_c} * \mathrm{lab}_{\mathrm{fo,t}}^{(1-\lambda_c)}$

(14)

where $1-\lambda_c$ and λ_c represent informal and formal labour division. Similarly, the aggregate wage can be written as: $\mathrm{W_t} = \left(\frac{\mathrm{W_{inf,t}}}{\lambda_c}\right)^{\lambda_c} \left(\frac{\mathrm{W_{fo,t}}}{1-\lambda_c}\right)^{1-\lambda_c} \frac{\mathrm{Lab_t}}{A}$ **(15)**

Further, within each sector, the different households (j) have monopolistic power over the differentiated labour service they supply, in line with Dixit and Stiglitz (1977). In addition, the economy is characterised by a set of perfectly competitive labour service assemblers that aggregate labour supply into two sets: $(\mathbf{Lab_{inf,t}})$ from non-Ricardian households and $(\mathbf{Lab_{fo,t}})$ from Ricardian households. These sets of labour are used by intermediate goods producers to produce formal and informal goods.

<u>Ricardian Households' labour Supply and Wage</u>

The labour service unit for formal Households is defined as:

$$\mathbf{Lab_{fo,t}} = \left[\int_{\mathbf{0}}^{1} \mathbf{Lab_{fo,t}}(j)^{\frac{\epsilon_{lab}-\mathbf{1}}{\epsilon_{lab}}} \boldsymbol{d}\mathrm{j}\right]^{\frac{\epsilon_{lab}}{\epsilon_{lab}-\mathbf{1}}} \tag{16}$$

Where parameter $\boldsymbol{\epsilon_{lab}}$ is the elasticity of substitution between the different types of labour services. The optimal demand for labour service units is the result of a cost-minimising problem, taking into account the differentiated wages set by each formal/Ricardian household. Indeed, the demand for household j's labour services will be: $\mathbf{Lab_{fo,t}}(\mathrm{j}) = \left(\frac{\mathbf{W_{fo,t}}(\mathrm{j})}{\mathbf{W_{fo,t}}}\right)^{-\boldsymbol{\epsilon}_{\mathbf{lab}}} (1 - \lambda_c)\mathbf{Lab_t}$

where $\mathbf{W_{fo,t}}(j)$ corresponds to the formal household *j*'s wages and the aggregate wage index is defined as: $\mathbf{W_{fo,t}} = \left[\int_{\mathbf{0}}^{\mathbf{1}} \mathbf{W_{fo,t}}(\mathrm{j})^{1-\boldsymbol{\epsilon}_{lab}} \boldsymbol{d}\mathrm{j}\right]^{\frac{\mathbf{1}}{1-\boldsymbol{\epsilon}_{lab}}}$ (17)

<u>Non-Ricardian Households' labour Supply and Wage</u>

Similar to the formal sector, the labour demand from household *j* in the informal sector will be:

$$\mathbf{Lab_{inf,t}} = \left[\int_{\mathbf{0}}^{1} \mathbf{Lab_{inf,t}}(j)^{\frac{\epsilon_{lab}-\mathbf{1}}{\epsilon_{lab}}} \boldsymbol{d}\mathrm{j}\right]^{\frac{\epsilon_{lab}}{\epsilon_{lab}-\mathbf{1}}} \tag{18}$$

where $\mathbf{W_{inf,t}}$ corresponds to household j's set wage rate in the informal sector, and is defined as:

$$\mathbf{W_{inf,t}} = \left[\int_{\mathbf{0}}^{\mathbf{1}} \mathbf{W_{inf,t}}(\mathrm{j})^{1-\boldsymbol{\epsilon}_{lab,i}} \boldsymbol{d}\mathrm{j}\right]^{\frac{\mathbf{1}}{1-\boldsymbol{\epsilon}_{lab,i}}} \tag{19}$$

6.3.2.5 Wage Setting Process

Similarly to Erceg et al. (2000), the wage-setting process internalises a Calvo-type nominal rigidity. This affects the dynamics of the whole system of equations, and hence also affects this model since Calvo-contracting allows a proportion of firms to reset their prices in any given period (albeit with a constant probability). Thus, in line with the standard literature, a certain degree of stickiness is assumed to exist among both the Ricardian and non-Ricardian households. This implies that in every given period a proportion of households can reset their wages based on economic conditions, such as prices, consumption, shocks, etc., while the other part is setting wages based on past inflation. As suggested in the existing literature, it is assumed that wage stickiness is higher among Ricardian (formal) households as they are more likely to be locked into contracts. Thus, as soon as the household sets its wage, it must meet labour demand at that wage.

Further, it is assumed that all households (formal or informal) follow a similar updating rule; when a household cannot re-optimise its set wage during i periods between t and $t+i$, the wage is expressed as:

$$\mathbf{W}_{t+i}(\mathrm{j}) = \boldsymbol{\Gamma}_{\mathbf{w,t}}\mathbf{W}_{\mathbf{t}}(j) \tag{20}$$

where $\boldsymbol{\Gamma}_{\mathbf{w,t}}$ is the wage adjustment rule expressed as:

$$\boldsymbol{\Gamma}_{\mathbf{w,t}} = \prod_{\mathbf{j=1}}^{\mathbf{i}}\left(\mathbf{1}+\boldsymbol{\pi}_{\mathbf{t+j-1}}\right)^{\boldsymbol{\xi}_{\mathbf{lab}}}\left(\mathbf{1}+\overline{\boldsymbol{\pi}_{\mathbf{t+j}}}\right)^{\mathbf{1-\xi_{lab}}}(1+\mathbf{g}_y) \tag{21}$$

This "passive" adjustment rule suggests that working households unable to optimally reset their wages to reflect prevailing economic conditions will simply accept a wage based on a geometric weighted average of past CPI inflation and the government inflation target captured by $\overline{\boldsymbol{\pi}_{\mathbf{t+j}}}$. The expression $(1+\mathbf{g}_y)$ is used, as suggested by Medina and Soto (2007), to ensure that the expression above does not diverge significantly from the economy's steady-state growth path.

A household j that **can re-optimise its wages** at t is given by solving the following maximisation problem:

$$\max_{\mathbf{W_t}(j)}\mathbf{E}_{,\mathbf{t}}\left\{\sum_{\boldsymbol{i=0}}^{\infty}\boldsymbol{\phi}_{\boldsymbol{Lab}}^{\boldsymbol{i}}\,\boldsymbol{\Lambda}_{\boldsymbol{t,t+1}}\left(\frac{\mathbf{W_t(j)\Gamma_{w,t}}}{\mathbf{P}_{\boldsymbol{t+1}}}-\boldsymbol{\zeta}_{\boldsymbol{t}}\left(\boldsymbol{lab}_{\boldsymbol{t+i}}(\boldsymbol{j})\right)^{\boldsymbol{\sigma_{lab}}}\left(\boldsymbol{C}_{\boldsymbol{t+i}}-\boldsymbol{h}\left(\mathbf{1}+\mathbf{g}_y\right)\boldsymbol{C}_{\boldsymbol{t+i-1}}\right)\right)\boldsymbol{Lab}_{\,\boldsymbol{t+i}}(\boldsymbol{j})\right\}$$

(22)

subject to the labour demand in the sector in which it is operating and the updating rule for agents unable to reset their nominal wage defined by equation (16). Hence, wage dynamics influence consumption through equation (18). Moreover, the variable $\boldsymbol{\Lambda_{t,t+1}}$ captures the discount over the period t and $t+i$.

6.3.3 Domestic Production

6.3.3.1 Oil sector

The oil sector is assumed to employ a marginal and fixed proportion of the labour force and capital investment in this sector is assumed to be of foreign origin. Thus, oil production is considered exogenous and captured by this expression:

$$\frac{\tilde{y}_{o,t}}{\tilde{y}_{o}} = \left(\frac{\tilde{y}_{o,t-1}}{\tilde{y}_{o}}\right)^{\rho_{yo}} exp\left(\varepsilon_{t}^{yo}\right) \qquad \textbf{(23)}$$

where $\rho yo \in (0, 1)$ is an auto-regressive coefficient and $\boldsymbol{\varepsilon_t^{yo}} \sim i.i.d\ N(0, \boldsymbol{\sigma_{yo}^2})$ is the resource shock related to the production process. The model also assumes that the country does not have any market power over this commodity; thus, the price of this commodity is set internationally and $\boldsymbol{P_{o,t}^*}$ r is given, and changes, according to the expression below:

$$\frac{P_{o,t}^*}{P_{o}^*} = \left(\frac{P_{o,t-1}^*}{P_{o}^*}\right)^{\rho_{po}} exp\left(\varepsilon_{t}^{po}\right) \qquad \textbf{(24)}$$

where $\boldsymbol{\rho_{po}} \in (0, 1]$ is an auto-regressive coefficient and $\boldsymbol{\varepsilon_t^{po}} \sim i.i.d\ N(0, \boldsymbol{\sigma_{po}^2})$ is the oil price shock.

In addition, oil GDP expressed in units of the domestic consumption basket is:

$$\boldsymbol{y_{o,t} = \varepsilon_t P_{o,t}^* \tilde{y}_{o,t}} \qquad \textbf{(25)}$$

Thus, increased oil production has a direct impact on the domestic economy through GDP. As it is assumed that the oil sector operates as an enclave and uses no domestic inputs, the increased production results correspond to a windfall gain. The expansion of the technological frontier is assumed to be biased towards tradable goods; thus, an oil boom will result in an exchange-rate appreciation. This is likely to result in higher exports, and the size of the appreciation will reflect structural parameters capturing the degree of intra-temporal and inter-temporal substitution in aggregate demand and production.

6.3.3.2 Domestic Goods - Non-Oil Sector

In this model, final formal goods are produced by using formal intermediate goods. Similarly, informal goods are produced using inputs produced by the informal sector. Differentiated goods are produced by the formal intermediate firms, using hired labour as well as private capital and enhanced by better access to public goods. These goods are sold to formal-final-good-producers operating in a monopolistically competitive market. Informal intermediate goods are produced by only using labour as inputs. These goods are sold to informal-final-goods-producers in a monopolistically competitive market. In both the formal and informal sectors, final goods are produced by packaging intermediate goods **a**t no cost and at the price of at which they are bought from the retailers. These final goods of both sectors are sold competitively.

Domestic Retailers – Aggregating Domestic Goods

The model assumes that there is a large number of firms using CES technology to produce, under perfect competition, formal and informal final home goods, with the intermediate goods produced domestically. These retailing firms sell those goods domestically and internationally (discussed below in the foreign sector section). To express this, $\mathbf{Y_{H,t}}$ captures the quantity of home goods sold domestically, which is the weighted sum of the formal ($\mathbf{Y_{Hf,t}}$) and informal ($\mathbf{Y_{Hi,t}}$) goods.

The demands for particular intermediate formal and informal varieties by each set of assemblers are given by:

$$\mathbf{Y_{Hf,t}}(\mathbf{z_{Hf}}) = \mathbf{Y_{H,t}}\left(\frac{\mathbf{P}_{\boldsymbol{Hf},\mathbf{t}}(\mathbf{z_{Hf}})}{\mathbf{P_{Hf,t}}}\right)^{-\boldsymbol{\epsilon}_{\mathbf{H}}} \quad \text{and} \quad \mathbf{Y_{Hi,t}}(\mathbf{z_{Hi}}) = \mathbf{Y_{H,t}}\left(\frac{\mathbf{P}_{\boldsymbol{Hi},\mathbf{t}}(\mathbf{z_{Hi}})}{\mathbf{P_{Hi,t}}}\right)^{-\boldsymbol{\epsilon}_{\mathbf{H}}} \qquad \textbf{(26)}$$

where $\mathbf{P}_{\boldsymbol{Hf},\mathbf{t}}(\mathbf{z_{Hf}})$ and $\mathbf{P}_{\boldsymbol{Hi},\mathbf{t}}(\mathbf{z_{Hi}})$ correspond to the prices of the formal goods variety $\mathbf{z_{Hf}}$ and informal goods variety $\mathbf{z_{Hi}}$ used to produce formal and informal home goods sold domestically. $\mathbf{P}_{\boldsymbol{Hf},\mathbf{t}}$ and $\mathbf{P}_{\boldsymbol{Hi},\mathbf{t}}$ are the corresponding aggregate-price indices.

Intermediate goods production

Home intermediate goods producers are assumed to operate under monopolistic conditions. The model also assumes that these producers are facing sticky prices as they cannot optimally adjust prices in every period.

Formal sector Intermediate goods production

Firms producing intermediate goods have monopoly power. They maximise profits by setting prices subject to demand for their differentiated goods and the technology used. $\mathbf{Y_{Hf,t}}$ corresponds to the aggregate quantity of domestically produced goods by the formal sector, also defined as the sum of the particular variety $\mathbf{z_{Hf}}$. Given the available technology, this takes the general form of:

$$\mathbf{Y_{Hf,t}} = A\left[((1-\lambda_c)Lab)^{\alpha} \mathrm{K}^{\beta_k} \mathrm{K_g}^{1-\alpha-\beta_k}\right] \qquad \textbf{(27)}$$

Where $\mathbf{Lab}$ corresponds to labour input used, and $\mathbf{K}$ stands for capital used in the production of that variety. In addition, in relation to public capital goods $\mathbf{K_g}$, in the same spirit as Ncube et al. (2017), it is assumed that public goods enhance formal private-sector production. αN is the sectoral income's labour share, and $\boldsymbol{\beta_k}$ is the output elasticity with respect to capital, and $\mathbf{1} - \alpha - \beta_{\boldsymbol{k}}$ is the output elasticity with respect to public capital. Variable $\mathbf{A_t}$ corresponds to a productivity shock affecting firms in the model. This is similar to work done by Conesa et al., (2002) who were the first to differentiate between formal and informal goods production in the labour market by assuming differentiated technology in the standard RBC model.

Given the price-setting process discussed below, the firm aims to minimise costs as follows:

$$min\{K, Lab, K\} w(1-\lambda_c)Lab + RK + R_g K_g \qquad (28)$$

where $\boldsymbol{R_t}$is the private capital goods' rental price; $\boldsymbol{R_t}$ corresponds to the rental price of public goods and $\boldsymbol{W_{fo,t}}$ to the wage of the formal sector. Firms assess the required quantity of inputs by minimising production costs subject to the available technology presented in equation (23). $\mathrm{Y_{Hf,t}} = A\left[((1-\lambda_c)Lab)^{\alpha} \mathrm{K}^{\beta_k} \mathrm{K_g}^{1-\alpha-\beta_k}\right]$

From the cost minimisation problem, the following expression for the nominal marginal cost is obtained:

$$\mathrm{MC_{Hf}} = Y w^{\alpha} R^{\beta_k} \mathrm{K_g}^{1-\alpha-\beta_k} \left(\frac{1}{\alpha}\right)^{\alpha} \left(\frac{1}{1-\alpha-\beta_k}\right)^{1-\alpha-\beta_k} \left(\frac{1}{\beta_k}\right)^{\beta_k} \qquad (29)$$

Equation 29 indicates that the MC is defined by input prices and the technology level. Therefore, the MC does not depend on the scale of production of a specific firm, and the cost of capital rental is defined as:

$$R = A\,\beta_k \left[((1-\lambda_c)Lab)^{\alpha} \mathrm{K}^{\beta_k}\, \mathrm{K_g}^{1-\alpha-\beta_k}\right] \qquad (30)$$

<u>Informal sector</u>

Similar to a formal firm, a representative firm from the informal sector has the following production function, taking into account that labour is the only input. Limited access to public goods (assumed nil) and assumed productivity in the sector is lower than in the formal sector. Thus, the firm has to minimise costs according to wages – the only input production:

$$\mathrm{Y_{Hi,t}(z_{Hi})} = \mathrm{A_t}\left[\left(\lambda_c \mathrm{Lab_t(z_{Hi})}^{\omega z}\right)\right] \qquad \textbf{(31)}$$

where $\boldsymbol{\omega_Z}$ acts as a penalty on productivity for operating in the informal sector. Thus, the maximisation problem of the firm is as follows: $\min\limits_{wage} \lambda_c\, \mathrm{Lab_t(z_{Hi})}^{\omega z}\, \mathrm{W_{i,t}}$

Using the price of labour, we can write the nominal marginal cost as:

$$\mathrm{MC}_{i,\mathrm{t}} = \mathrm{A}_{H,t}^{-1}\left[\, W_{i,t}^{\omega_z}\right] \qquad \textbf{(32)}$$

6.3.3.3 Price Setting

It is assumed that prices are set in a similar way in both formal and informal sectors, following Calvo's staggered price-setting rule, which supposes that a proportion of producers (i.e. ϕ_i) can adjust prices in any period. The value of ϕ_i will be higher for the informal sector, given that it is more competitive than the formal sector. Those firms which do not adjust their prices between $t \; and \; t+i$, adjust their prices in $t+i$ following $\Gamma_{H,t}P_{H,t}$, where Γ_H is the updating rule.

When a firm adjusts its prices in response to shocks, then it maximises the following function:

$$\boldsymbol{\sum\nolimits_i^{\infty} \phi_i, E_t \left\{ \Lambda_{t,t+i} \frac{\left(\Gamma_{i,H,t} P_{H,t}^{op} - MC_{H,t+i}\right)}{P_{t+i}} Y_{H,t+1}(z_H) \right\}} \qquad (\mathbf{33})$$

subject to the demand for this type of good $(\mathbf{z_H})$ being driven by:

$$\mathbf{C_{H,t}(z_H)} = \left(\frac{\mathbf{P}_{\boldsymbol{H},\mathbf{t}}\mathbf{(z_H)}}{\mathbf{P_{H,t}}}\right)^{\boldsymbol{\epsilon}_{\mathbf{H}}} \left(\mathbf{C_{H,t}} + \boldsymbol{C}^{*}_{\boldsymbol{H,t}}\right) \quad \mathbf{(34}$$

where $\boldsymbol{\epsilon}_{\mathbf{H}}$ refers to the price elasticity of demand for a variety of the corresponding good $\mathbf{z_H}$. It indicates that the demand for product $\mathbf{z_H}$ (formal and informal) is contingent on the domestic consumption of home goods (formal and informal) and consumption of domestic goods by foreign agents (to increase realism we assume that a small proportion of informal goods are exported).

The "passive" rule for firms that cannot adjust prices between t and $\boldsymbol{t+1}$ is given by: $\boldsymbol{\Gamma}_{\mathbf{i,H,t}} = \prod_{\mathbf{j}}^{\mathbf{i}}\left(\mathbf{1} + \boldsymbol{\pi}_{\mathbf{H,t+j-1}}\right)^{\boldsymbol{\xi}_{\mathbf{H}}}\left(\mathbf{1} + \boldsymbol{\pi}_{\mathbf{t+j}}\right)^{\mathbf{1}-\boldsymbol{\xi}_{\mathbf{H}}}$ $\quad(\mathbf{35})$

The parameter $\boldsymbol{\xi}_{\mathbf{H}}$ reflects the strength of "indexation", meaning that larger values imply that past inflation has a significant impact on the price adjustment process. This is in line with standard Calvo staggered pricing. The expression is $\mathbf{1} + \boldsymbol{\pi}_{\mathbf{H,t}} = \left(P_{\mathbf{H,t}}/P_{\mathbf{H,t-1}}\right)$, where $\boldsymbol{\pi}_{\mathbf{t+j}}$ is the government's inflation target. Thus, firms that cannot optimally adjust prices consider the inflation target (set in terms of consumer goods inflation) in their pricing decision.

6.3.4 Foreign Sector

In the model, the Nigerian economy is assumed to export only two sets of goods: formal consumption goods and oil. For the sake of simplicity, it is assumed that the oil that is produced is exported (see section 6.2.3.1 above). Domestic goods demand from the rest of the world is expressed as follows:

$$C^{*}_{H,t} = \gamma^{*} \left(\frac{\mathbf{P}^{*}_{\boldsymbol{H},\boldsymbol{t}}}{\mathbf{P}^{*}_{\boldsymbol{F},\boldsymbol{t}}}\right)^{-n^{*}} C^{*}_{t} \qquad (36)$$

where γ^{*} is the weight of domestically produced goods in the foreign agents' consumption basket, while n^{*} refers to the price elasticity of demand. By assuming that domestic firms cannot price discriminate across markets, the law of one price is set to hold for domestically produced goods sold internationally: $\boldsymbol{P}^{*}_{\boldsymbol{H},\boldsymbol{t}} = \frac{\mathbf{P}_{\boldsymbol{H},\boldsymbol{t}}}{\boldsymbol{\varepsilon}_{\boldsymbol{t}}}$

The real exchange rate is the ratio of the domestic consumption basket and price of the foreign consumption basket in a domestic currency, expressed as $\mathbf{RER}_{\boldsymbol{t}} = \frac{\boldsymbol{\varepsilon}_{\boldsymbol{t}}\mathbf{P}^{*}_{\boldsymbol{F},\boldsymbol{t}}}{\mathbf{P}_{\boldsymbol{C},\boldsymbol{t}}}$ **(37)**

6.3.5 Monetary Policy Rules

The model's monetary policy is characterised by a simple real-interest rate feedback rule. Under the model baseline assumptions, the country's central bank reacts to changes in CPI inflation away from its target, as well as the deviation growth of output from the long-run trend.

The Central Bank of Nigeria (CBN) is taken to be following a partial implementation of an Inflation Targeting Regime, implying that CPI targets are pre-announced every year. For the baseline analysis in this paper, the real interest rate is the key policy instrument. This chosen rule allows the CBN to internalise changes in the desired optimal level of output at a long-run level, thus also helping to capture the fact that the CBN also follows an exchange rate target.

Under the alternative policy, a rule-based on nominal interest rates as the key policy instrument is specified. This adds a direct policy reaction to the oil variations.

In summary, the following rule to characterise the monetary policy has been developed:

$$\frac{1+r_t}{1+r} = \frac{1+r_{t-1}{}^{\rho_i}}{1+r}\left(\frac{Y_t}{Y_{t-1}}\frac{1}{1+g_y}\right)^{(1-\rho_i)\overline{\omega_\pi}}\left(\frac{1+\pi_t}{1+\bar{\pi}_t}\right)^{(1-\rho_i)\overline{\omega_\pi}} \exp\left(v_t\right) \qquad (38)$$

where π_t corresponds to the inflation target set for period t and $r_t = (1+i_t)/E_t(P_{t+1}/P_t) - 1$ is the net real interest rate. $(Y\_t/Y\_(t-1) * 1/(1+g\_y))$ is the deviation from the long-run steady-state growth rate. Variable v_t captures the monetary policy shock, reflecting deviations from the policy rule.

6.3.6 Fiscal Policy

6.3.6.1 Spend as You Go - Baseline

The model's fiscal element is composed of the country's national budget and the SWF. Government spending, including both consumption and investment, is a composite of tradable and non-tradable goods. This expenditure is financed through revenues from oil and non-oil taxation. Furthermore, it is composed of government-received interest-income from oil revenues saved, and from domestic and international borrowing. In each period, oil revenues in excess of the fiscal target are saved in the SWF. In the case of fiscal deficit, the government draws from the fund, unless the balance is below a pre-determined level. In the case of the SWF's lower boundary becoming a binding constraint, the gap is covered either through external borrowing, spending or tax adjustments.

The government flow budget constraint is given by:

$$\tau_{Y,t}Y_t + \frac{D_t-(1+i)D_{t-1}}{P_t} + \frac{M_t-M_{t-1}}{P_t} + R_t^g K_{g,t-1} + t_{O,t} = G_{k,t} + T \qquad (39)$$

Tax revenue, new bond issues, return on public capital and oil tax revenues are sources of income for the government, who spends it on public capital investment and transfers. Resource revenue is defined as: $t_{O,t} = \tau_O P_{O,t}^* \, \tilde{y}_{O,t} + div(1 - vacrco - \tau_O)P_{O,t}^* \tilde{y}_{O,t} - fco * y$

where $(1 - vacrco - \tau_O)P_{O,t}^* \tilde{y}_{O,t} - fco * y$ is the oil sector profit, and div is the part of revenue accruing to the state coffers; $varco$ corresponds to the oil sector costs expressed as a per cent of the resource output; fco refers to oil production's fixed costs as a proportion of GDP and τ_O is a constant royalty rate paid by firms.

The accumulation of public capital follows this rule:

$$K_{g,t} = G_{k,t} + (1 - \delta)K_{g,t-1}$$

Thus, government constraint becomes:

$$\tau_{Y,t}Y_t + \frac{D_t-(1+i)D_{t-1}}{P_t} + \frac{M_t-M_{t-1}}{P_t} + (1 + R_t^g - \delta)K_{g,t-1} + t_{O,t} = K_{g,t} + T \qquad (40)$$

Under the baseline, government spends revenue as it receives it and adjusts expenditure accordingly. This suggests a full oil volatility pass-through to the economy. For simplicity's sake, I assume that the government does not run a deficit.

Under the alternative scenario, the excess crude account is modelled whereby the government saves part of the revenue above a certain threshold, and it has saved and spent it in the following period if there is a shortfall in revenue (i.e. a deficit) in order to smoothen its expenditure.

6.3.6.2 Bird in Hand Rule (BIH rule)

The BIH rule implies saving all revenues accruing from the oil sector in a specific fund: a Sovereign Wealth Fund (SWF). Then, the policy entails that the government only consumes the interest on accumulated assets. This policy is similar to the one applied in Norway, post-1990. Under this policy, the resource balance is $RB_t = \varepsilon_t(1 + r^*)F_t$, where $(1 + r^*)$ is the risk-free interest earned on the savings. F_t are oil-related foreign assets (i.e. the sovereign wealth fund). $E_t\left[M_{t,t+1}F_{t+1}\right] = \left[1 - (1 + r^*)F_t + t_{O,t}\right]$

Thus, the government constraint becomes

$$\tau_{Y,t}Y_t + \frac{D_t-(1+i)D_{t-1}}{P_t} + \frac{M_t-M_{t-1}}{P_t} + (1+R_t^g-\delta)K_{g,t-1} + RB_t = K_{g,t} + T \quad (41)$$

6.3.6.3 Modified Bird in Hand

The modified BIH rule consists of saving all oil revenues in a SWF similar to the BIH, but government consumes a fixed proportion of accumulated assets. In this case, the resource balance is, $RB_t = \rho_{HB}F_t$, where ρ_{HB} is the proportion of the sovereign wealth fund spent each year. F_t are oil-related foreign assets (i.e. the sovereign wealth fund). $E_t[M_{t,t+1}F_{t+1}] = [1- \rho_{HB}F_t + t_{O,t}]$

So, the government constraint becomes

$$\tau_{Y,t}Y_t + \frac{D_t-(1+i)D_{t-1}}{P_t} + \frac{M_t-M_{t-1}}{P_t} + (1+R_t^g-\delta)K_{g,t-1} + RB_t = K_{g,t} + T \quad (42)$$

6.3.6.4 Aggregate Equilibrium

The equilibrium conditions in the home goods sector and the labour market imply:

$$Y_{H,t}(z_H) = C_{H,t} + C_{H,t}^{*}+I_t + G_{k,t} \quad (43)$$

$$l_t = L_{H,t}$$

$P_{Y,t}$ denotes the implicit output deflator. Then, in the model, total GDP —at current prices— is captured by: $\frac{P_{Y,t}}{P_t}Y_t = C_t+I_t + G_{k,t} + \frac{P_{X,t}}{P_t}X_t - \frac{P_{M,t}}{P_t}M_t$ (44)

where the total value of exports is : $\frac{P_{X,t}}{P_t}X_t = \frac{P_{H,t}}{P_t}C_{H,t}^{*} + \frac{P_{S,t}}{P_t}Y_{S,t} + \frac{y_{O,t}}{P_t}$ and where $y_{O,t}$. is per Ncube. It is assumed that domestic oil gets exported, and imports are captured as $\frac{P_{M,t}}{P_t}M_t = RER_tC_{F,t} + \frac{\varepsilon_t P_{O,t}^{*}}{P_t}O_t$

Finally, the net foreign asset position is: $\frac{\varepsilon_t B_t^{*}}{[1+i_t^{*}]\Theta\left(\frac{\varepsilon_t B_t^{\mathrm{F}}}{P_{X,t}X_t}\right)P_t} = \frac{\varepsilon_t B_{t-1}^{*}}{P_t} + \frac{P_{X,t}}{P_t}X_t - \frac{P_{M,t}}{P_t}M_t$ (45)

6.4 Model Calibration

Although the objective is to understand the impact of an oil shock in developing resource-rich countries with specific characteristics, as well as assessing the implications for developing economies of resource revenue saving and spending decisions, this model is calibrated for

Nigeria's economy, which, as presented throughout this study, represents a good case study of a developing economy dependent on natural-resource revenues.

Deep parameter values are selected by matching average ratios for the period 2000-2014 and using standard values presented in the relevant literature. Furthermore, values for some parameters were obtained from estimated macroeconomic structural equations, while several parameters have been based on the country's national accounts and steady-state ratios.

Thus, for the calibration, the first step is to use the Nigerian averages in a wide range of international data sets, such as the world economic outlook, international financial statistics and world development indicators for the period 2000 to 2014. The imports as a share of GDP amount to 25% of GDP (M_Y) and the export share is estimated at 37% of GDP (X_Y), implying a trade balance of 11.4% of GDP over the period. The choice of the period is guided by the relative economic stability and consistency in monetary and fiscal policies within that period. Nigeria is considered to be at an advanced stage of oil production as the oil sector (O_Y) represents 36.7% of GDP at the initial steady-state (BP Statistical Review 2014). It is also assumed that oil produced is fully exported and represents 87% of exports (O_X). Other tradable goods (Chstar_X) represent 13% of GDP, of which a small proportion is from informal goods – 5% of informal goods (gamma2). Out of total domestic production (excluding oil), 60% is assumed (gamma1) to be formal goods and 40% informal.

The other components of GDP are such that consumption (C_Y) represents about 71% of core GDP over the period, of which 80% is by Ricardian households and 20% by non-Ricardian households. This corresponds to the consumption of the richest top 40% of the population (see Ben E. Aigbokhan, 2017). It is assumed that the top 40% of the population is Ricardian. Fifteen per cent of total imports is oil imported for domestic consumption, while the remaining imports are assumed to be consumption goods. This reflects the specific situation of several oil-rich developing countries which export oil and find themselves importing oil at a market price for their domestic refineries, when they exist. In addition, core consumption is divided: 60% are domestic goods (Ch_Yh) and 40% imported (gamma).

In the absence of better data on the weight of imported goods in the Nigerian CPI basket, the imports share of GDP should better approximate the degree of pass-through. This share is not particularly high, and, as hinted by Habib et al. (2008), it may be on the conservative side. Like domestic production, it is assumed that, out of domestic consumption, 60% is the consumption of formal goods and 40% of informal goods – this reflects the GDP production of the formal and informal sectors, estimated by the National Bureau of Statistics (NBS).

The government expenditure averaged 26% of GDP, of which 19 percentage points represent government consumption and 7% percentage points represent government capital investment (KG_Y) – in line with fiscal data of the country, with capital investment representing on average about 40% of the annual budget (see Chapter 3). Finally, private investment is presented as the residuals.

Households and Labour:

The discount factor $\boldsymbol{\beta}$ (beta), which is a benchmark of forward-looking behaviour, has been computed to be 0.99 by taking the inverse of average long-term real interest rates. This i is confirmed in the existing literature on developing countries and Nigeria (See Ncube et al. 2017).

The coefficient of labour supply in the utility function (sensitivity of labour supply to real wages) is fixed at 3 for the non-Ricardian household (sigma_li) and to 1.5 for the Ricardian household (sigma_lf), following the literature (i.e. Sembeta 2013 and Ahmed 2012). These values correspond to similar estimates in the U.S. (Rabanal et al. 2005), Pakistan (Ahmed, 2012) and Uganda (Zeufach, 2016). Further, it is assumed that non-Ricardian households are more sensitive to wages than Ricardian households, given their reliance on wages. This literature finds the unemployment elasticity of real hourly wages for informal workers to be 3.5 times the estimate for formal workers in the context of Turkey, for example (Baltagi et al. 2012). The difference between elasticity in the formal and informal sectors in the model represents the range of values presented in the literature. This reflects the complexity of the informal sector, in terms of the wide range of types of activities in the developing country setting.

Further, h, the habit formation coefficient, is estimated at 0.49, in line with the meta-analysis conducted by Havranek et al. (2015). This estimate is in line with findings in Hungary (Jakab and Világi, 2007); however, it is smaller than in Europe (Adolfson et al., 2007) and higher than in Chile (Medina and Soto, 2007). The calibration choice is justified by imported oil being included in the households’ consumption basket, with an elasticity of substitution between oil and core consumption estimated at eta = 0.2 - less than one, and oil shocks, independently of habit formation, having an impact on aggregate consumption.

The elasticity of substitution between home and foreign goods, θ, is estimated at 0.97, reflecting the developing nature of the economy under consideration. In turn, the demand elasticity of home goods in the foreign economy, eta_star, is estimated at 1.14 (in line with the unitary Chilean estimate, lower than in the case of Jordan) pointing to a significant price elasticity of foreign demand. Nigeria is not a significant exporter of non-oil tradable goods, and in terms of oil it remains a price-taker. Finally, in line with the country's exchange rate policy, Nigeria faces an elasticity of risk premium on its foreign borrowing, estimated at 0.012 by the Central Bank.

The coefficient of wage indexation on the informal sector (phi_li) is estimated to be 0.619, while the coefficient for the formal sector (phi_lf) is estimated at 0.819, suggesting a relatively high level of wage indexation and reflecting a limited ability to absorb shocks. This reflects the complex wage-setting process where wages in the public sector and oil sector are affecting levels of wages in the rest of the economy. Wages in those sectors, in particular the public sector, are rigid and impact wages in the other sectors (Stevenson, 1992). As indicated by Ramzi (2006), the informal sector employs a significant part of the labour force in many developing countries. This sector is defined as less organised and less regulated as minimum wage laws and other types of regulation are either absent or weakly implemented. Thus, indexation to past inflation rates is weaker. However, workers in the informal sector have flexible wages compared to formal sector workers. Nevertheless, wages in the formal sector have an impact on the informal sector's wages.

Contrary to wage stickiness, evidence from developing countries indicate that price indexation is relatively low - phi_h is set at 0.16. Alidou (2014) and Choudhary et al. (2011) found similar results, which showed that firms promptly accommodate to changes in (a) cost, in particular related to key inputs, (b) competitors' prices and (c) the exchange rate. This implies that prices depend less on past levels.

Also, the low degree of financial literacy and the difficult access to finance imply that a large proportion of Nigerian households cannot access formal financial institutions. Therefore, it is assumed that 63% of households in Nigeria behave using a rule-of-thumb rule, in line with Ncube (2017), and data related to financial inclusion in the country, with lambdac =0.37.

Production

Private capital is relatively low, based on evidence from the firm-level survey indicating that firms are labour intensive (Chapter 2), so private capital share is set at 0.2. Furthermore, government presumably plays a role in enhancing private investment (alpha_kg) by bringing in a share of capital to about 0.4, which is in line with Ncube (2016) and Nwafor et al. (2011). The depreciation rate for government capital has been set at 0.07, as shown by Ncube (2017), while the depreciation rate for private capital was set at 0.10 to reflect the fact that these goods have higher economic obsolescence than public capital goods.

The probability of formal firms being able to reset wages (i.e. the Calvo probability) is estimated at 0.37 and 0.54 for the informal sector – reflecting the assumption that only Ricardian households are assumed to operate in the formal sector, and are thus more likely to be protected by contracts. Calvo probabilities (for firms not able to reset prices) are set at 0.308 for the informal sector against 0.17 for the formal sector. The informal sector is more competitive than the formal sector (Ramzi, 2006). Thus, the probability of an informal firm resetting its prices is 0.9, compared to 0.7 for a formal firm. Ahmed (2012) undertook a firm-level survey in Pakistan and found that the median price change frequency in the manufacturing sector was estimated at 6, while this figure drops to 2 for the services sector. The equivalent figures in Europe and the US are estimated at 1 and 1.4, respectively (Jakab and Világi, 2007). In addition to the overall low-price stickiness, the informal market Calvo parameter reflects the fact that the informal sector is competitive, as part of the literature argues that informality results from a profit-driven decision, allowing entrepreneurs to gain a competitive advance (Allen and Schipper 2016; Ahmed 2011). Overall, this implies that domestic wages are not adjusted as often as home goods prices.

The elasticity of substitution between oil and core consumption (eta) is 0.2, in line with estimates of oil-rich developing countries such as Jordan. This elasticity is lower than the Chilean estimate (Medina and Soto, 2007), illustrating g the historically poor performance of the power (electricity generation) sector in Nigeria and several other developing countries, as well as technological constraints. Additionally, elasticity of substitution of labour in oil production is estimated at -0.207, which is relatively inelastic and in line with Soto and Medina (2007). This parameter is important to determine the impacts of an oil-price shock on several key variables such as output, marginal cost and inflation. In addition, a penalty (omega z) on labour productivity for operating in the informal sector was assumed and linked to the difficult access to public goods.

Policy Function

The Taylor Rule responses to inflation and output were obtained by regressing nominal interest rates on inflation and output steady-state deviations. Thus, in line with Ireland (2004), omega_y and omega_pi are estimated to be 0.82 and 0.07, respectively. Steady-state gross inflation has been estimated to be 0.117 annually. These parameters are in accordance with those provided by Adebiyi et al. (2011).

Fiscal Policy

The royalty tax rate, τo, is set at 0.95 in line with Ncube (2017), which corresponds to the value allowing for an initial steady-state ratio of natural-resource revenue to total revenue to be at 60% of total revenues (IMF, 2014). In addition, non-resource revenue is estimated around 20% of GDP at the initial steady-state, reflecting the implied inefficiency in revenue mobilisation.

Under the alternative scenario, it is assumed that government will seek to save about 25% of oil revenue (res-floor). This corresponds to the average difference between market prices and budgeted oil prices in the period 2000-2013.

Shock related process

Regarding the three shock processes, the approach developed by King and Rebelo (2000) and presented in the annexe is followed.

6.5 Response of Economy to Structural Shocks

The model can be used for policy analysis by assessing the impulse response functions (IRF) resulting from different exogenous structural shocks in it. IRFs are estimated and presented in Chart 36. A shock in the model is found in the responses of endogenous variables' to a 1 standard deviation increase in the shock parameter. Although the model allows one to analyse several possible shocks, such as technology, interest rate and foreign demand, the rest of the analysis will focus on the shock to the relative prices of oil.

6.5.1 Spending as You Go – Baseline Scenario

The oil price shock, described in Chart 36, represents 1 standard deviation increase in the international price of oil (prostar). By assuming the law of one price, the domestic price of oil (pro) also increases in a similar fashion. Given the increase in international oil prices, the value of domestic oil production increases (oh). This results in higher oil royalties and, therefore, an increase in government revenue and spending (g), given its take in the oil industry. In addition, given that the oil produced is exported, exports (x) increase. In sum, increased exports and higher government revenue and spending will impact the domestic economy.

The increase in exports leads to a nominal appreciation of the exchange rate (d_e). The appreciation (higher d_e) pushes down domestic prices (in particular of non-oil tradable goods) as formal sector firms, to remain competitive, reduce the prices of their products. However, as discussed below, the price of non-tradable goods is increasing, reflecting the labour price which is the sole input, and there is a gradual increase in demand for non-tradable outputs. In response, in aggregate and given the contribution of the informal goods to the consumer basket, prices are increasing. In response to this, the Central Bank reacts by increasing interest rates (i) to dampen inflation, reversing initial appreciation and slowly bringing nominal exchange and prices back to their steady states.

These dynamics will affect households and firms' behaviour. Indeed, the initial nominal appreciation implies that demand for domestically produced formal goods are lower (yhf). This is further illustrated by the tradable impulse response function (IRF) (yht), which is competing with imports (m) that are relatively cheaper, thus they are increasing. These dynamics results in lower total tradable home goods production (yh). As part of the adjustment to tradable goods prices, formal sector firms decrease investment (inv) and, because of price stickiness, the process is gradual and capital stock decreases gradually over time (k), before increasing as the shocks are being absorbed. This is confirmed by the DD framework predictions, and this is despite the increase in government capital investment. Furthermore, if it is assumed that capital investment contributes to "learning by doing" and thus to future growth, then the economy will be on a different growth path – beyond the model specification. This firm-level decision also has an impact on the labour market, with the aggregate number of hours worked initially decreasing (lab_f).

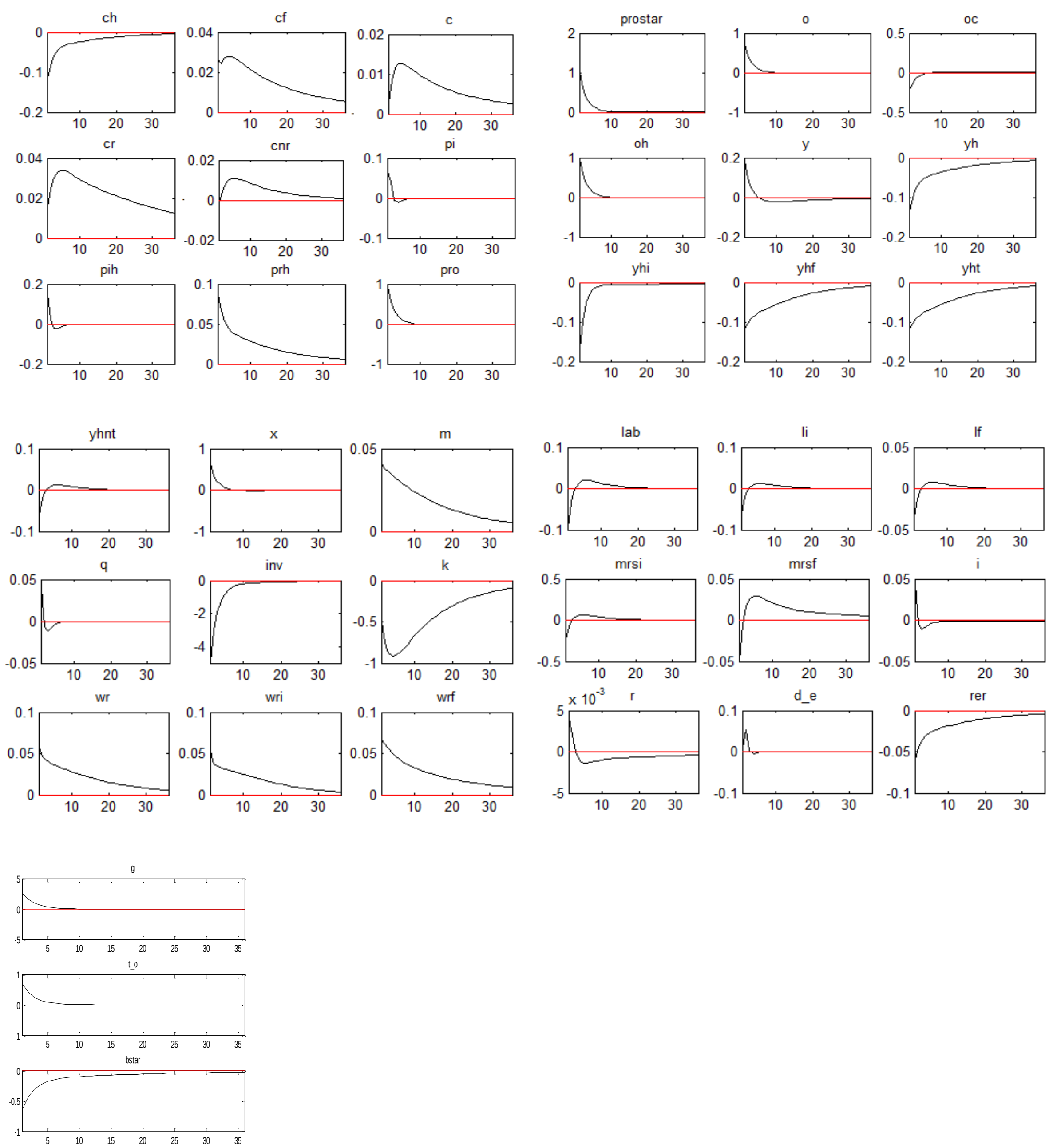
The Ricardian households, operating in the formal sector, are also affected through capital rent(q), which is initially increased to reflect the interest rate before decreasing to reflect lower output in the formal sector. However, as formal firms are competing with the oil sector for labour and under the assumption that the part of the increase in (g) will increase civil service wages, wages paid to Ricardian households in the formal sector (wrf) are also increasing, despite the lower output. This is part of the DD spending effect as the relative price of home goods rises (prh) when the higher direct impacts of the oil boom (i.e. higher wage and profits in the resource sector, as well as higher tax revenues) result in higher demand for non-tradable goods, assuming that there is positive income elasticity of demand for non-tradables.

Following the price movement and the nominal exchange rate appreciation, the real exchange rate (lower rer) appreciates. This rise in the relative price of non-tradable goods is a result of the wage spillover from the oil-producing sector, and the increase in government spending, which is allocated to civil servant wages. The impact of the appreciation of the RER on the non-oil tradable sector can be aggravated by the nominal exchange rate appreciation resulting from "petrol dollars" inflows. This results in the decline in domestic output (yhf) and employment (lf), with wages moving in a different direction to the number of hours worked. It also points to de-industrialisation, where the non-oil tradable sector struggles to compete. In this model, as a particular shock fades away, output from the formal sector gradually returns to its steady state.

In addition, given the ability of Ricardian households to smoothen consumption, driven by habits in consumption and in part by the dividend received by those households, their consumption actually increases (cr). The size of the consumption increase is also impacted by the monetary policy response, (i) and (r). This increase in demand also feeds increased imports, with the consumption of home (ch) and foreign goods (cf) being higher. In contrast, demand for foreign bonds decreases.

Concurrently, the production of informal goods (yhi) initially drops as overall wages increase, which prices labour out of this sector as the only input for these firms is labour. However, as demand from Ricardian households gradually increases, reflecting higher wages and lower interest rates and boosting domestic demand for all type of goods, (yhi) increases quickly. Informal wages (wri) (as demand from non-Ricardian households increases) also increases and becomes positive. This is reflected in higher wages, resulting in higher consumption – which gradually reduces and reverts back to equilibrium as the shock is slowly absorbed.

Chart 36: Impulse Response Functions to Oil Shock



Overall, consumption is higher under the baseline due to stronger performance of the non-commodity sectors. The model above highlights that wages and numbers of hours worked will move in opposite directions, as a result production of the formal/ tradable sector decreases, in line with DD predictions. In this context, the justification for using fiscal policy tools to consolidate the fiscal position is to depress demand and contain inflation (Corden 2012). The lower interest rate also reflects the fact that government demand for bonds is lower, pushing interest rates downwards (van der Ploeg 2011). Further, under these assumptions, the government may not avoid the Dutch Disease effect given the impact on capital and investment in the formal sector, as well as on wages and prices.

6.5.2 Alternative Scenarios

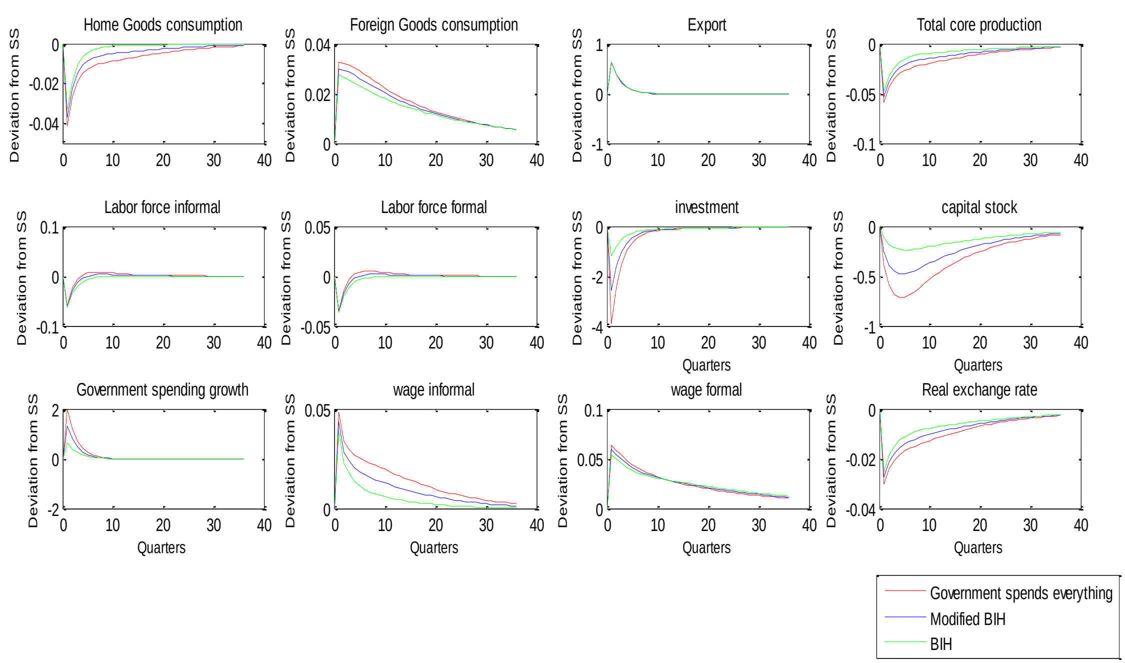
There are a number of potential fiscal rules pertaining to the relationship between resource-revenue inflows into public spending. As presented by Kopits and Symansky, (1998), a fiscal rule refers to a usually permanent and potentially binding constraint imposed on fiscal policy aggregates. These constraints are numerical values imposed on fiscal/budgetary parameters, such as revenue, debt or spending. Independently of the type of rules, they need to be supported by a number of institutional mechanisms to ensure their enforcement. In this context, fiscal rules help to formalise the quantum of resource revenue to be spent in any fiscal year.

Under the Bird in Hand scenario, it is assumed that the government partially smooths its spending of a temporary windfall by only spending interest accumulated on all oil revenues saved in a sovereign wealth fund. The BIH rule will impact the modelled economy in three distinct phases: i) consumption increases and results in terms of trade appreciation; ii) then government spending will only gradually rise under the BIH rule, dampening the real exchange-rate and gradually crowding out consumption; and then iii) the terms of trade depreciate to their new steady-state. However, compared to the other options, it has a lesser impact on capital and investment as well as on wages – highlighting the difficult trade-off between capital investment and keeping wages under control, given its poverty reduction potential. Further, as regards the monetary policy implied in the model, the currency peg or the standard Taylor Rule, the rise of government spending will create inflationary pressure; the opposite is true in the case of lower government spending.

Similarly, the modified BIH rule implies the government will save all oil revenues in a SWF and spend only a fixed proportion of these revenues. In Nigeria, this is similar to the oil-revenue distribution between the national budget and the revenue stabilisation fund: in the case of Nigeria, called the Excess Crude Account (ECA). The accrual to the ECA is based on the difference between the actual international oil price and a benchmark price determined in preparation of the yearly budget. In the Nigerian case, the ECA insulated the economy from the recession following the slump in global oil prices in 2009. The impact in this model is half-way between the BIH and the spending-as-you-go rules.

The Chart 37 below indicates that the alternative scenario shows that this type of rule will have a limited impact on mitigating the cyclicality observed in many resource-rich countries. It may, however, have some temporary welfare impact as consumption and production recover faster through government spending, thus boosting domestic formal production. Under the alternative scenario, the fall in investment is delayed, and thus is not as abrupt. The real exchange-rate also returns to equilibrium faster. In sum, saving matters, in particular for mitigating the impact of oil shocks on an informal sector.

Chart 37: Selected Impulse Response Functions under Different Policy Options



The two options presented above (BIH and the modified BIH) do not necessarily isolate the economy from possible volatility or act as a stop-gap measure for the underlying mechanisms leading to the manifestation of the Dutch Disease. This implies that the fiscal rule on its own may not support efforts to mitigate the effect of oil revenues on the economy (raising the question about the context with regards to shallow financial markets, where monetary policy may have a limited impact). Saving or spending on its own may therefore not be sustainable. Further, as pointed to by Stiglitz (1984), beyond the DD framework, the possible destruction of firms and banks' informational and organisational capital as a result of a recession can have long-term impacts.

In addition, human capital will be affected, reflecting the impact of macroeconomic volatility on growth prospects. This volatility will also impact poverty levels, education outcomes and inequality. Thus, extreme volatility is more likely to harm the more vulnerable strata of the population as they have limited opportunities to smooth out consumption due to limited access to credit, for example. The World Bank (2006) further indicates that in the absence of adequate social safety nets, the nutritional impact on the population can be irreversible, as is usually the case in developing countries (see World Bank, 2006).

6.6 Conclusions

In this chapter, I have developed a general equilibrium model with the inclusion of an informal sector, wage and price stickiness, as well as credit-constrained households – a number of characteristics that pertain to a developing country's economy.

This study is relevant as it presents labour-market frictions within the New Keynesian framework and includes features relevant to a developing country context, such as a dual labour market. Only a few studies have included duality in a real business cycle model instead of in a New Keynesian model. Thus, those models focused on a closed economy instead of an open economy model, which describes most developing-country economies. The model employed here introduced duality in the simple fashion; however, it did so in order to be representative of the characteristics of the type of economy under study.

The informal labour market is considered more competitive than the formal sector. The same was assumed for the price-setting process. In line with Senbeta (2013), it has been argued that the whole economy presents a formal and informal sector duality. Therefore, the adjustment through which firms can employ both types of workers is not included in this model.

The different impulse responses of the variables of interest reflect economic theory and empirical evidence. However, the presented results do not support the conclusion of a strand of the literature that suggests the existence of a flexible informal sector acting as a stabilising force to mitigate possible shocks (see Castillo and Montoro 2012; and Ahmed 2012). This is in line with findings from Senbeta's study (2013).

In addition, developing countries are more volatile and less prepared to absorb shocks. To further illustrate this point, a number of fiscal policies often recommended to resource-rich countries, such as the Bird in Hand and an adjusted version of this policy have been considered. Although these policies affect the intensity of the shocks and reduce the crowding-out effects on private investment, they do not protect a developing country's economy from volatility. Independently of the fiscal rule, an oil shock will imply an immediate terms of trade appreciation as consumption of private and public agents increase. Under a nominal currency peg or standard Taylor Rule, this leads to inflation, and a recession characterised by less investment in capital.

6.7 Annexe

6.7.1 Calibration Parameters

Households parameters		
gamma1	0.6	Formal goods share in domestic production
gamma2	0.95	Proportion of informal goods in non-tradable sector
G_Y	0.26	Govt spending in GDP
KG_Y	0.07	Govt capital investment in GDP
O_Y	0.367;	Oil to GDP ratio
Ch_Yh	0.6	Domestic goods consumption in core GDP
C_Y	0.713	Consumption in GDP
X_Y	0.246	Export to GDP ratio
M_Y	-0.37	Import to GDP ratio
Chstar_X	0.128	Foreign consumption of non-oil goods in export
O_X	1-Chstar_X	Share of Oil in total export
Cf_X	0.8	Foreign goods consumption as a proportion of export
I_Y	1-G_Y-X_Y-C_Y-M_Y	Investment in GDP
Cnr_Y	0.2	Non Ricardian consumption in GDP
WL_Y	0.05	Wages of informal sector in GDP
Gamma	0.4	Share of imported goods in domestic consumption
Households- related parameters		
lambdac	0.63	Informal labour share in labour force
Beta	0.99	Discount factor
sigma_lf	1.5	Inverse labour elasticity
sigma_li	3	Inverse labour elasticity
H	0.49	Habit coefficient
eps_li	4	Wage mark-ups
eps_lf	2	Wage mark-ups
Eta	0. 2	Core/oil elast. subst.
eta_star	1.14	Elast. frgn demand
Varrho	0.012	Elast. risk. Premium
Theta	0.97	Home/Foreign goods elast. substit.
phi_li	0.619	Wage rigidity
phi_lf	0.819	Wage rigidity
phi_h	0.166	Price rigidity – price stickiness of home goods
Production		
delta_k	0.1	Capital depreciation rate
delta_kg	0.07	Government capital depreciation rate
omegaz	0.8	Productivity factor of informal labour
xi_li	0.108	Weight past inflation – proportion adjusting price?
xi_lf	0.308	Weight past inflation
xi_h	1-lambdac	Weight past inflation – wages?

omega	-0.207	Labour cost elasticity with respect to oil production
alpha_kg	0.2	Share of government capital input in the core production
alpha_k	0.2	Share of capital input in the core production
g_y	0.045/4 ;	Annual long-run labour productivity growth
g_pi	0.117/4	The long-run annual inflation rate
chi	=1/(1+g_y)/(1+g_pi)	
Policy Function		
omega_pi	1.5	Inf. weight pol. Rule
omega_y	0.5	Out. weight pol. Rule
omega_o	0	Oil weight pol. Rule
	Fiscal Policy	
tau_o	0.95	Royalty rate on natural resources production
div =	0 ;	Additional dividend share by govt
T_Y	G_Y	Oil and non-oil government revenue to GDP ratio
varco	0 ;	Cost coefficient in the oil sector
fco	0 ;	Fixed cost in production of oil
res_floor	0.25	Targeted level of government reserve change
RES_Y	0.02	Marginal effect of economic growth on the changes in government reserves
	Shock Related	
rho_z	0.9	Labour productivity shock
rho_istar	0.991	AR frgn int. shock
rho_a	0.936	AR product. Shock
rho_zeta	0.521	AR utility shock
rho_psi	0.968	AR oil lop shock
rho_pistar	0.14	AR frgn. inflat shock
rho_cstar	0.881	AR frgn. cons. Shock
rho_s	0.917	AR exports shock
rho_prostar	0.9	Oil relative price shock in the foreign markets
rho_r	0.85	AR policy rule
rho_upsilon	0.6	AR of MP shock
rho_tau	0.9	AR gov. spending
rho_dg	0.9	AR gov. deposits

6.7.2 Log-Linearised Model

The model is log-linearised using standard Taylor expansions around the steady state. The steady state productivity level, such as $A_H = \frac{\epsilon_H}{\epsilon_H - 1}$, and the labour disutility parameter ζ are normalised so real wage is 1 in the steady state. In addition to these two normalisations, the foreign currency price level of imported goods is chosen such as all relative prices are one.

In line with the literature (Medina et al., 2007; Beidas-Strom et al., 2011) standard log linearisation procedures (Sims, 2015), the variables in lower case with the symbol "$\widehat{\ }$", capture the log deviation with respect to the steady state. The real price is defined as $\widehat{pr}_{J,t} = \hat{p}_{J,t} - \hat{p}_t$. Similarly, real wage is $\widehat{wr}_{J,t} = \widehat{w}_t - \hat{p}_t$.

Consumption and Aggregate demand

The log-linearised expressions of the domestic consumption of home goods and domestic consumption of foreign goods are:

$$\hat{c}_{H,t} = (1-\gamma)\,(\theta-\eta)\,\widehat{rer}_t - (\theta(1-\gamma)+\gamma\eta)\widehat{pr}_{H,t} + \hat{c}_t \tag{A1}$$

$$\hat{c}_{F,t} = (1-\gamma)\,(\theta-\eta)\,\widehat{rer}_t - (\theta(1-\gamma)+\gamma\eta)\widehat{pr}_{H,t} + \hat{c}_t \tag{A2}$$

$$\hat{O}_{C,t} = -\eta\,\widehat{pr}_{O,t} + \hat{c}_t \tag{A3}$$

Within the above equations, $\widehat{rer}_t = \hat{e}_t + \hat{p}^*_{F,t} - \hat{p}_t$, where $\hat{p}^*_{F,t}$ is the price of imported goods in foreign currency. $\widehat{rer}_t$ is the log deviation of the real exchange rate from its steady state level. One of the underlying assumptions is the fact that the law of one price holds for imported goods; thus, the equation for domestic prices of foreign goods is: $\hat{p}_{F,t} = \hat{e}_t + \hat{p}^*_{F,t} - \hat{p}_t$.

Using the optimal condition, the Euler equations for the different types of households (Ricardian and non-Ricardian) are:

$$\hat{c}^R_t = \frac{1}{1+h}E_t\hat{c}_{t+1} + \frac{h}{1+h}\hat{c}_{t-1} - \frac{1-h}{1+h}(\hat{\imath}_t - E_t\hat{\pi}_{t+1}) \tag{A4}$$

$$\widehat{\psi_t} = \frac{E_t[1+\hat{c}_{t+1}] - (1+\beta)h(1+\hat{c}_t) + h((1+\hat{c}_{t-1})}{E_t[1+\hat{c}_{t+1} - h(1+\hat{c}_t)] - (1+\hat{c}_t) - h(1+\hat{c}_{t-1})}$$

and from the FOC: $\widehat{\psi_t} = E_t\hat{\psi}_{t+1} - E_t\hat{\pi}_{t+1} + \hat{r}_t$

Regarding non-Ricardian consumption based on wage only, the following was obtained from equation 13.

$$\hat{c}^{NR}_t = \lambda_c Lab + \widehat{wr}_\iota \tag{A5}$$

Production, Aggregate Supply and Inflation

Informal sector:

For the informal sector, output is defined as $\widehat{Y_{inf,t}} = \hat{a}_{H,t} + \lambda_c\left[\widehat{Lab}_t + \omega_z \widehat{z_{H,t}}\right]$

(A6)

where home goods technology is expressed as follows:

$\hat{a}_{H,t} = \rho_a \hat{a}_{H,t-1} + \varepsilon_{a,t}$

(A7)

and $\widehat{z_{H,t}}$ represents a productivity shock following an AR(1) process of the form:

$$\hat{z}_{H,t} = \rho_z \hat{z}_{H,t-1} + \varepsilon_{z,t} \quad \text{(A8)}$$

Furthermore, the productivity level in the informal sector is discounted by the factor $\omega_z$representing lower productivity in the sector.

By combining the optimal choice of wages under the existing updating rule and the aggregate real wages, the following log-linear expression for the informal sector is obtained:

$\frac{1+\upsilon_{Li}\phi_{Li}+\sigma_{Li}\epsilon_{Li}(\upsilon_{Li}+\phi_{Li})}{1+\sigma_{Li}\epsilon_{Li}}\widehat{wr}_{i,t} - \phi_{Li}\widehat{wr}_{i,t-1} - \upsilon_{Li}E_t\widehat{wr}_{i,t+1} = \frac{\omega_z\,(1-\upsilon_{Li})(1-\phi_{Li})}{1+\sigma_{Li}\epsilon_{Li}}\widehat{mrs}_{i,t} -$
$(\phi_{Li} + \upsilon_{Li}\xi_{Li})\hat{\pi}_{Hi,t} + \phi_{Li}\xi_{Li}\hat{\pi}_{Hi,t-1} + \upsilon_{Li}E_t\hat{\pi}_{Hi,t+1} + \widehat{\zeta_t}$

(A9)

where $\upsilon_L = \beta\phi_L$ and the subscript i or l defining the sector informal or formal, respectively. Variable $\widehat{\zeta_t} = \frac{(1-\upsilon_L)(1-\phi_L)}{1+\sigma_L\epsilon_L}\ln\left(\frac{\zeta_t}{\zeta}\right)$ refers to a shock to the labour disutility parameter, which is assumed to be expressed as:

$$\hat{\zeta}_t = \rho_\zeta \hat{\zeta}_{t-1} + \varepsilon_{\zeta,t} \quad \text{(A10)}$$

The marginal rate of substitution between labour and consumption, $\widehat{mrs}_{t,}$ for the informal sector is given by:

$$\widehat{mrs}_{i,t} = \sigma_{Li}\lambda_c Lab + \frac{1}{1-h}\hat{c}_t^{NR} - \frac{h}{1-h}\hat{c}_{t-1}^{NR} \quad \text{(A11)}$$

Formal sector:

Similar to the equations above, the following log-linear equations related to production in the formal sector are obtained.

From the production function, the following is the log-linearised expression of output in the domestic formal goods sector: $\widehat{Y_{fo,t}} = \hat{a}_{H,t} + (1-\lambda_c)\alpha\left[\widehat{Lab}_t + \widehat{z_{H,t}}\right] + \beta_K \widehat{k_\iota} + (1-\alpha-\beta_K)\ \widehat{k_{g,t}}$ (A12)

where $\widehat{z_{H,t}}$ represents a productivity shock following an AR(1) process of the form: $\hat{z}_{H,t} = \rho_z \hat{z}_{H,t-1} + \varepsilon_{z,t}$

By combining the optimal choice of wages with the updating rule and the definition of the aggregate real wages, the following is the log-linear expression for the formal sector:

$$\frac{1+\upsilon_{Lf}\phi_{Lf}+\sigma_{Lf}\epsilon_{Lf}(\upsilon_{Lf}+\phi_{Lf})}{1+\sigma_{Lf}\epsilon_{Lf}}\widehat{wr}_{f,t} - \phi_{Lf}\widehat{wr}_{f,t-1} - \upsilon_{Lf}E_t\widehat{wr}_{f,t+1} = \frac{(1-\upsilon_{Lf})(1-\phi_{Lf})}{1+\sigma_{Lf}\epsilon_{Lf}}\widehat{mrs}_{f,t} - (\phi_{Lf}+\upsilon_{Lf}\xi_{Lf})\hat{\pi}_{Hf,t} + \phi_{Lf}\xi_{Lf}\hat{\pi}_{Hf,t-1} + \upsilon_{Lf}E_t\hat{\pi}_{Hf,t+1} + \hat{\zeta}_t \quad \text{(A13)}$$

and the formal sector marginal rate of substitution is:

$$\widehat{mrs}_{f,t} = \sigma_{Lf}(1-\lambda_c)ZLab + \frac{1}{1-h}\hat{c}_t^R - \frac{h}{1-h}\hat{c}_{t-1}^R \quad \text{(A14)}$$

Capital accumulation:

$$\hat{k}_t = (1-\lambda_k)\hat{k}_{t-1} + \lambda_k \hat{\iota}_{t-1} \quad \text{(A15)}$$

Rental price

$$\hat{r}_t = \hat{a}_{H,t} + (1-\alpha)\widehat{Zlab}_t + (\beta-1)\hat{k}_t + (1-\alpha-\beta)\hat{k}_{g,t} \quad \text{(A16)}$$

Oil production

The evolution of commodity exports, $\hat{O}_t = \rho_O \hat{O}_{t-1} + \varepsilon_{O,t}$ (A17)

External sector

The domestic interest rate is defined as:

$$\hat{\imath}_t = \hat{\imath}_t^* + \mathbf{E}_t \boldsymbol{\Delta} \hat{\mathbf{e}}_{t+1} + \boldsymbol{\varrho} \hat{\boldsymbol{b}}_t^* \quad \textbf{(A18)}$$

where $\hat{\boldsymbol{b}}_t^* = \boldsymbol{ln}\left(\frac{\boldsymbol{\varepsilon_t B_t^*}}{\boldsymbol{P_{X,t} X_t}} / \frac{\boldsymbol{\varepsilon_t B^*}}{\boldsymbol{P_X X}}\right)$. This expression of net foreign interest rate $\hat{\imath}_t^*$ captures both the international relevant interest rate and any exogenous variations in the risk premium not captured by $\boldsymbol{\varrho \hat{b}_t^*}$. This is expressed as follows:

$$\hat{\imath}_t^* = \rho_{i^*} \hat{\imath}_{t-1}^* + \varepsilon_{i^*,t} \quad \text{(A19)}$$

Let $\hat{\pi}_t^* = \hat{p}_{F,t}^* - \hat{p}_{F,t-1}^*$ be foreign inflation expressed in foreign currency. By using this expression with the definition of the RER, the following expression is obtained:

$$\widehat{rer}_t = \widehat{rer}_{t-1} + \Delta \hat{e}_t + \hat{\pi}_t^* - \hat{\pi}_t \quad \text{(A20)}$$

Foreign inflation is captured by the exogenous process presented as:

$$\hat{\pi}_t^* = \rho_{\pi^*} \hat{\pi}_{t-1}^* + \varepsilon_{\pi^*,t} \quad \text{(A21)}$$

where $E_{t-1}(\varepsilon_{\pi^*,t}) = 0$ and $E_{t-1}(\varepsilon_{\pi^*,t}^2) = \sigma_{\pi^*}^2$

Market clearing condition for home goods:

$$\hat{y}_{H,t} = \frac{C_H}{Y_H} \widehat{c_{H,t}} + \frac{Y_H - C_H}{Y_H} \hat{c}_t^* - \eta^* \frac{Y_H - C_H}{Y_H} \left(\widehat{pr}_{H,t} - \widehat{rer}_t\right) \quad \text{(A22)}$$

The ratio $\frac{C_H}{Y_H}$ represents the domestic households' steady-state consumption share of domestic goods. From the definition of total GDP, the log-linearised version of total output is:

$$\hat{y}_t = \frac{C}{Y} \hat{c}_t + \frac{X}{Y} \hat{x}_t - \frac{M}{Y} \widehat{m_t} \quad \text{(A23)}$$

where $\frac{C}{Y}$ is the steady-state consumption as a proportion of GD, $\frac{X}{Y}$ is total exports divided by GDP and $\frac{M}{Y}$ corresponds to the total imports as a share of GDP.

The de-trended and log-linearised exports equation is expressed as:

$$\hat{x}_t = -\eta^* \frac{C_H^*}{X} \left(\widehat{pr}_{H,t} - \widehat{rer}_t\right) + \frac{C_H^*}{X} \hat{c}_t^* + \frac{O}{X} \widehat{O}_t \quad \text{(A24)}$$

The domestic net foreign asset position is expressed as:

$$(1-\varrho)\widehat{\beta b_t^*} = \beta i_t^* + \chi \widehat{b_{t-1}^*} + \chi \hat{x}_{t-1} + \frac{C_H^*}{X} \chi \widehat{pr}_{H,t-1} + \chi\left(\Delta \widehat{\mathrm{O}}_t - \pi_t\right) + \left(\frac{P_X X}{\varepsilon B} - \beta\right) \hat{x}_t + \left(\frac{P_X X}{\varepsilon B} - \beta\right) \frac{C_H^*}{X} \widehat{pr}_{H,t} - \frac{P_X X}{\varepsilon B} \frac{M}{X} \hat{m}_t - \frac{P_X X}{\varepsilon B} \frac{C_F}{X} \widehat{rer}_t - \frac{P_X X}{\varepsilon B} \frac{O}{X} \widehat{pr_{O,t}^*} \quad \text{(A25)}$$

where $\chi = \frac{1}{(1+\pi^*)(1+g_y)}$

Relative Prices

By associating the optimal price-setting equation to the equation allowing for a passive price-resetting equation (35), domestic inflation on home goods is:

$$\widehat{\pi_{H,t}} = \frac{(1-\phi_H)(1-\beta\phi_H)}{\phi_H(1+\beta\xi_H)} (1-\alpha)\, \widehat{wr}_t + \beta_k \widehat{R_t} + (1-\alpha-\beta_k)\widehat{R_{g,t}} - \hat{A} - \widehat{pr}_{H,t} + \frac{\beta}{1+\beta\xi_H} E_t \hat{\pi}_{H,t+1} + \frac{\xi_H}{1+\beta\xi_H} \hat{\pi}_{H,t-1} \quad \text{(A26)}$$

where $\widehat{wr}_t$ is the weighted average, such as $\widehat{wr}_t = \lambda_c \widehat{wr}_l + (1-\lambda_c)\, \widehat{wr}_f$ (A27)

The real price of domestic goods and oil, expressed in domestic currency, are captured by the following equations:

$$\widehat{pr}_{H,t} = \widehat{pr}_{H,t-1} - \hat{\pi}_{H,t} - \hat{\pi}_t \quad \text{(A28)}$$

$$\widehat{pr}_{O,t} = \widehat{rer}_t + \widehat{pr}_{O,t}^* + \hat{\psi}_t \quad \text{(A29)}$$

The international real price of oil is the international relative price of oil with respect to the foreign price index captured by:

$$\widehat{pr}_{O,t}^* = \rho_O \widehat{pr}_{O,t-1}^* + \varepsilon_{O,t} \quad \text{(A31)}$$

$\hat{\psi}_t$, capturing the law of one price deviations for oil, follows an AR(1) process, such as:

$$\hat{\psi}_t = \rho_\psi \hat{\psi}_{t-1} + \varepsilon_{\psi,t} \quad \text{(A32)}$$

Furthermore, using the CPI definition and core consumption price-levels, the relationship between the real prices of oil and domestic goods, as well as RER, is expressed as:

$$0 = \delta \widehat{pr}_{O,t} + (1-\delta)\gamma \widehat{pr}_{H,t} + (1-\delta)(1-\gamma)\widehat{rer}_t \quad \text{(A32)}$$

Policy Rule

The log-linearised expression of the baseline monetary policy rule is:

$$\hat{r}_t = \rho\hat{r}_{t-1} + (1-\rho)\varpi\widehat{\pi_t} + (1-\rho)\varpi_y(\hat{y}_t - \hat{y}_{t-1}) + \hat{v}_t \qquad \text{(A34)}$$

where brt is the steady state deviation of the real interest rate such as:

$$\hat{r}_t = \widehat{ir}_t - E_t\hat{\pi}_{t+1} \qquad \text{(A35)}$$

Finally, the monetary shock is given by:

$$\widehat{v}_t = \rho_v\widehat{v_{t-1}} + \varepsilon_{v,t} \qquad \text{(A36)}$$

Fiscal Rule

The Spend-it-all rule consists of spending oil revenue as it is received. In log-linear form it is expressed as:

$$\hat{k}_{g,t} = \widehat{rer}_t + \hat{p}ro_t + \widehat{to}_t$$

The BIH rule involves saving all oil revenues in a SWF and spending only the interest accumulated on the saved assets.

$$\hat{k}_{g,t} = \widehat{rer}_t + \hat{r}_t^*\hat{f}_t$$

where$\hat{f}_t = \hat{f}_{t-1} + \widehat{to}_{t-1}$

The modified BIH rule corresponds to saving all oil revenues in an SWF and consuming only a fixed proportion of these revenues.

$$\hat{k}_{g,t} = \widehat{rer}_t + \rho_{HB}\hat{f}_t$$

where $\hat{f}_t = \hat{f}_{t-1} + \widehat{to}_{t-1}$

Market clearing:

Aggregate consumption:

$$\hat{c}_t = (1-\lambda_c)\hat{c}_t^r + \lambda_c\,\hat{c}_t^{nr}$$

Aggregate wages:

$$\widehat{wr}_t = (1-\lambda_c)\widehat{wr}_{fo,t} + \lambda_c\widehat{wr}_{inf,t}$$

Aggregate output as expressed in equation A23:

$$\hat{y}_t = \frac{C}{Y}\hat{c}_t + \frac{X}{Y}\hat{x}_t - \frac{M}{Y}\widehat{m}_t$$

where $\frac{C}{Y}$ is the consumption ratio to GDP in steady state, $\frac{X}{Y}$ is total exports to GDP ratio and $\frac{M}{Y}$ is the total imports to GDP ratio. In addition, non-tradable output is a proportion of informal sector production:

$$\hat{y}_{hn,t} = \gamma_2 \hat{y}_{inf,t}$$

And tradable output is a proportion of informal sector production and all formal production:

$$\hat{y}_{ht,t} = (1-\gamma_2)\hat{y}_{inf,t} + \hat{y}_{fo,t}$$

Thus, home production is:

$$\hat{y}_{h,t} = (1-\gamma_1)\hat{y}_{hn,t} + \gamma_1 \hat{y}_{ht,t}$$

The de-trended and log-linearised expression for imports is:

$$\widehat{m}_t = \frac{C_F}{M}\hat{c}_{F,t} + \frac{M - C_F}{M}\hat{o}_t$$

where total oil imports are given by:

$\hat{o}_t = \frac{O_c}{O}\hat{o}_{c,t}$

Chapter 7:
Concluding remarks

7.1 Introduction

This study has analysed the impacts of the Dutch Disease's predictions on labour market outcomes, such as employment levels and wages, in the context of a resource-rich developing country: in this case, Nigeria. The focus was placed on providing macroeconomic and microeconomic evidence of the labour market adjustment related to the direct impacts of oil-abundance and its related resource-revenue inflows, as well as related policies linked to the management of those revenues.

Four objectives were set at the beginning of this thesis. The first was to provide a rationale for the relevance of the study within the DD framework and the effect of oil revenues on the socio-economic development of Nigeria – often referred to as a perfect case study for the analysis of the resource curse. Second, given that the exchange rate is the main trigger of the DD mechanism, an analysis was undertaken, at the macro and micro levels, of the impact of the RER movement on the level of employment in Nigeria. Third, given the specificities of the oil-sharing arrangement, the question of whether oil has a key role in the wage determination process was investigated and quantification of its role in explaining wage inequality across firms in the country was sought. Fourthly, an assessment of how the economy reacts to short term shocks, given its large informal sector, and whether fiscal policies actually mitigate the possible impact of shocks on the Nigerian economy was attempted.

To achieve the above objectives, a number of approaches were used to answer the research and sub-research questions set out at the start of this thesis. First, a descriptive-analytical approach was used in Chapters 2 and 3 to critically present the Dutch Disease framework, and the impact of oil in the Nigerian context, using various aspects of the resource curse literature. These aspects included resource dependence, social tension, and fiscal and monetary policies. Then, Chapter 4 sought to present employment adjustment to real exchange rate movements (one of the DD's key predicted impacts) and used a VECM to assess the long-run relationship between the exchange rate and employment levels in both the manufacturing sector and at the aggregate level.

This was further complemented by panel survey analysis tools, such as GMM estimates, to present the short-run labour adjustment at the firm level. Thirdly, OLS and wage decomposition analysis (borrowed from the health literature) was used to assess the impact of oil-abundance in wage determination and the contribution of oil-abundance to wage inequality in the country. Finally, a DGSE model was built and Dynare used to evaluate the impact of shocks, in particular oil-related ones, and the possible fiscal policies that may be implemented in Nigeria to reduce possible economic distortions resulting from the transition to a new equilibrium.

7.2 Key contributions to the Literature

There are several studies devoted to natural resource production impacts on the growth performance of resource-rich economies. The Dutch Disease framework remains the key analytical tool through which to assess how the resource sector affects the economy, in particular in the short-run, through a number of channels such as the resource movement and the spending effect (Corden 1984, Corden and Neary 1982, and Neary et al., 1984). However, analysis of the direct impact of some of the predictions regarding the labour market has been relatively scarce and the empirical evidence of the existence has been inconclusive, in particular in the developing country context due to a number of market rigidities that developing countries face (Kojo, 2015).

The proposed approach was to take some of these different predictions of the framework and assess their impact on the labour market. Thus, this study is the first of its kind to test the real exchange rate impact on the labour market through the labour intensity channel (i.e. a substitution of labour for capital) in the Nigerian context. Further, it has presented both long- and short-term adjustments in the manufacturing sector. The short-term adjustment was based on the analysis of panel data and computed a trade-weighted exchange rate (a first in Nigeria).

The second innovation of this project lies in how it assesses the impact of oil on the wage determination process, as well as on the quantity of the impact of oil in wage inequality, for the first time in the Nigerian context. This contributes to the debate on the revenue sharing arrangement of the country, and its impact on the competitiveness of the country.

The third aspect of this study's innovation concerns how it introduces informality (an informal labour supply and informal labour demand) into an open economy setting that accounts for capital markets and assumes that oil revenue impacts the economy mainly through fiscal spending and capital investment. In addition, evidence of short-term adjustment of the economy to an oil shock is presented.

7.3 Major Conclusions

The thesis investigated the following main question: what is the impact of resource abundance (i.e. oil) on the labour market of a resource-rich developing country such as Nigeria? Beyond assessing the significance of oil revenue to the socio-economic development of Nigeria, the role these revenues played in various aspects of the labour market, mainly employment levels and wages, were examined through the lens of the Dutch Disease framework. The impact of the management of these revenues on the labour market was also assessed. This analysis was completed by assessing the impact of oil in the context of a large informal sector. Specifically, this study aimed at quantifying the impact of DD on different aspects of the labour market of a resource-rich developing country. The major results that were found through this study are summarised below.

7.3.1 What was the Rationale for the Focus on Nigeria?

To analyse these sub-questions, this study reviewed the historical development of the oil sector and its impact on a number of factors in Nigeria related to the resource curse literature, such as resource dependence, social tensions and several macro-economic variables, including GDP, as well as monetary and fiscal policies. These are the main points that were described:

a) This analysis emphasised that oil revenue only compounded a number of issues (such as weak political structure, regional disparities) which existed before oil extraction began in Nigeria.

b) The oil sector impacted the country's economic development, with a dependence that grew gradually from the 1970s onward. This dependence on oil has translated into increased economic volatility and inconsistent fiscal and monetary policies.

c) In relation to the impact of the oil sector, this has been shown to mainly take place through government revenue and spending, which has enabled the Nigerian government to expand consumption (i.e. recurrent expenditure – wages and costs of running the administration) and development (the impact of which has been limited because of a complex political economy context)

d) Oil revenue has therefore resulted in a higher demand for tradeable and non-tradeable goods, such as services. This has led to higher domestic price levels and an appreciation of the RER, which was artificially maintained at a high level by various policies. Thus, the government's policies are likely to have been the main channel through which oil revenue has affected the economy. Furthermore, although the oil sector is extremely capital intensive, with a high level of labour productivity, implying that the resource effect will be limited, it may have provided the impetus for upward-moving wages.

e) Finally, although the share of oil output as a share of GDP has been at most 30%, it has had an impact on the development of the non-tradable sector, negatively affecting the agriculture sector, preventing the growth of manufacturing (notably through adverse trade and exchange policy decisions) and encouraging an oversized services sector. This hints at the existence of the Dutch Disease effect.

7.3.2 What was the Role of the RER in Explaining Employment Performance in Nigeria?

The second main sub-question focused on the effect of REER movement (driven by oil inflows or related policies) on the level of employment in Nigeria through changes in the labour intensity channel (i.e. changes in the relative price of capital and labour).

7.3.2.1 What was the Role of the RER in Explaining Employment Performance in the Nigerian Manufacturing Sector?

Using a VECM, the presence of a long-run relationship between REER, employment and capital formation was assessed.

a) The above model used macroeconomic data to analyse the effect of the REER on the level of employment in Nigeria, both at the aggregate level and, more specifically, in the manufacturing sector. In the long-run, an exchange rate appreciation, as indicated by the model developed by Frenkel and Ros (2007), and as suggested by the labour intensity channel, decreased the employment level in the manufacturing sector and at the aggregate level by 0.165% and 0.02%, respectively.

b) Further, capital formation was shown to positively affect the level of employment. This is in line with the level of development of the country and the large infrastructure gap it faces in the quantity of infrastructure it possesses.

c) Short-term dynamics were inconclusive using macro data within a VECM analysis.

7.3.2.2 What was the Role of the RER in Explaining Employment Performance in the Nigerian Manufacturing Sector at the Micro-level?

Using a panel data survey and completing an analysis based on GMM estimators, the following points were highlighted regarding an eventual short-run relationship between the level of employment and a number of variables, including wages, sector-specific trade-weighted exchange rates and capital:

a) From a methodological point of view, the analysis took into account the specific characteristics of panel data. This included the simultaneity that occurs between employment and other variables of interest impacting one another in any given period. In this case, both OLS and fixed-effects estimates will be biased. The other issue that arose was that of unobservable heterogeneity. These factors were addressed through the use of a GMM estimator.

b) This study found that sector-specific exchange rate movements are linked to capital levels within these specific sectors but, more importantly, it was found that a 1% increase (appreciation) in the sector-specific REER will result in lower employment levels – a reduction of 0.021%. This suggests that firms react to labour costs being relatively more expensive in light of an appreciation against other factors of production such as capital (which is primarily imported in the Nigerian context, according to Kojo, 2014).

c) The findings also suggest a negative relationship between wages and firm employment (-0.132, t = 2.96), as predicted, *ceteris paribus*, by economic theory. In addition, capital is positively related to the level of employment, highlighting that, at the manufacturing firm-level, capital is complementary to the employment level.

d) Moreover, this analysis also indicated that capital and employment levels are complementary in the context of the Nigerian manufacturing sector, implying that an increase of capital is beneficial for job creation. However, the micro-evidence indicates a small impact of capital on employment (coefficient of 0.1), which is almost 2/3 smaller than the coefficient obtained at the macro level, reflecting the type of firms included in the survey.

Overall, this analysis indicated that although the coefficients between macro evidence and micro evidence differ in sizes, they confirm theoretical expectations. The difference in amplitude can be attributed to the data, including the number of firms with an average capacity rate of only 44%. Thus, the mechanism of interest will be more subdued. Nevertheless, a possible REER appreciation will have a negative impact on the level of employment, and this was shown to be the case both in the short-run (GMM analysis) and long-run (VECM analysis). The mechanism through which this can manifest itself at the firm level is through lower investment and profitability resulting from REER appreciation; however, firms will take advantage of the cheaper capital.

Furthermore, there does not seem to have been a substitution between capital and employment in the short and long-run as they both moved in similar directions, possibly reflecting the fact that the firms included in the survey mostly survived and, therefore, have growth potential in the Nigerian context. This could be explained by the fact that the sectors included in this survey (such as paper and furniture) can easily substitute labour for capital. However, this impact at the micro level was observed over a relatively short period of time.

7.3.3 What is the Role of Oil in Wage Determination and Wage Inequality in Nigeria?

The second key relationship observed here was the impact of the abundance of revenue on wages. According to the DD framework, wages are expected to be pushed upwards through aggregate demand feedback on the labour market. In assessing this prediction, the following evidence was found.

7.3.3.1 *What role does higher oil revenue distributed to specific sub-national entities play in determining wages?*

Based on a wage equation using cross-sectional enterprise survey data, the analysis indicates that:

a) In line with Dutch Disease theory and the mechanisms presented by Brunstad and Dyrstad (1997), oil has an impact on wages. Different measures of wages (total wage bills, wage per worker) with different specifications of the control variable, including a dummy variable for the oil region or the amount received by each state in the region, returned a consistent impact of oil on wages –commanding a wage premium of at least 10 % for firms located in oil-producing regions.

b) This effect was found across firms, sectors and even in firms that are assumed to be of similar productivity levels given their ability to export. Indeed, even among firms facing external markets, it was found that firms in the South-South region (the point-resource region in Nigeria) are paying a premium. Further, when looking at the difference across sectors, it was noted that the interaction term between the oil dummy and foreign exposure matters. Thus, both the manufacturing and services sector in those regions could be more cost-competitive if this oil premium on wages did not exist. The premium was estimated to be up to 55% for manufacturing firms and around 30% for firms operating in the services sector.

c) The observed differences in impact between services and manufacturing hints at a skills gap as service-related skills are readily available and less specialised. Thus, the wage offered is still higher in the oil-producing region, but it remains comparatively less important than the manufacturing sector’s wage premium.

d) This premium reflects several factors, all linked directly and indirectly by the abundance of resources at the local level. Firstly, efficiency wage and rent sharing theory could explain these results, where firms can reduce costs by increasing wages. With limited labour mobility in the country, employees are able to raise their wages through threats of withholding labour supply, and this situation is likely to be exacerbated in the oil-rich region. Also, higher wages could also be a way of compensating for higher costs of living, resulting in a local Dutch Disease effect.

7.3.3.2 How Do These Determinants (including Oil Revenue) Explain Wage Differentials across Firms?

This research project also aimed to investigate the decomposition of wage inequalities in Nigeria by applying a methodology developed initially by Wagstaff et al. (2001) to study inequalities. As far a is known, this analysis is the first to provide evidence on drivers of wage inequality in Nigeria and the role played by oil in this encounter. My study found that:

a) A mechanism such as the revenue sharing formula used by Nigeria will contribute to wage inequality in the country. This implies that after controlling for other determinants of wages, on average, firms in oil-rich regions are at least 10% more likely to be the ones with higher wages (or vice versa).

b) Although oil matters, the main source of inequality between firms is size. This can be attributed to the fact that larger firms lie at the root of wage inequality. It is also possible that smaller firms are not able to keep up in terms of efficiency and, thus, are similarly unable to keep up in terms of wages offered. Larger firms are paying wages that do not reflect productivity levels, reinforcing the Dutch Disease and rent sharing hypotheses. This could be further driven by the higher probability of larger firms of obtaining government contracts or better access to public goods, for example.

7.3.4 How Do Key Macroeconomic Variables Respond to Oil Shocks by Taking into Account Formal and Informal Labour Markets?

The last key relationship of interest to this project was the impact on the labour market of fiscal policy development in response to the abundance of oil, taking into consideration some of the characteristics of a resource-rich developing country's labour market, such as informality. The analytical work indicated:

a) The DSGE model includes a number of key features, such as price and wage rigidity, an informal labour supply, an informal production sector, public goods benefiting only the formal sector, limited labour mobility and the fiscal sector. All these features fall within an open economy context.

b) The analysis of the oil shocks indicated that an increase in government revenue increases spending, pushing consumption and wages upwards, while investment decreases; consumption of domestic goods, therefore, increases at the expense of imports, which decrease. This leads to inflation and exchange rate appreciation.

c) The informal sector, where households rely solely on wages, having no ability to save, does not play the role of a buffer and contributes to the Dutch Disease mechanisms (by spending the higher wage received).

d) The policy options presented by international institutions, like the IMF, recommend creating a savings account, such as a Sovereign Wealth Fund. Two versions of such a mechanism (Bird in Hand and Modified Bird in Hand) were tested. In the short-run, these were shown to have very little impact on managing short-term volatility in Nigeria. This is because they reduce the size of the distortion and thus preserve capital investment for future growth. All in all, informality does not have a shock-absorber role.

7.4 Policy Implications

The above discussion presenting the major results of this study demonstrates the key role that government has to play in promoting economic development and in mitigating the impact of Dutch Disease This entails supporting the growth of the non-oil sector, as well as generating real income and creating much-needed jobs. This will only be made possible if effective mechanisms are implemented to manage the impact of oil-related shocks on the labour market and non-oil sectors.

This analysis has highlighted several policy aspects that require the attention of developing country policymakers:

a) The **exchange rate policy** impacts the labour market, and thus an appreciation will affect firms' employment decisions. This means that a stable and predictable exchange rate is a prerequisite for job creation (as it affects profits and investment decisions). An over-valued or appreciated naira maybe be seen as a way to facilitate import-fuelled consumption; however, Nigerian firms currently have excess capacity and will therefore invest in little, which limits job creation. A more flexible exchange rate may increase demand for domestic goods and reduce that excess capacity.

b) The **investment policy**. Given that labour and capital are deemed to be complementary investments in well-implemented infrastructure projects, the development of a reliable and efficient power supply network will support production efforts and increase productivity.

c) The **revenue-sharing formula** in favour of oil-producing states is needed because of the environmental damage caused by the oil sector and the impact it has on the livelihoods of populations living in oil-producing regions. However, the current revenue-sharing model allows for excess revenue to fuel consumption, which has an implication at the local level through local inflation on wages, which affects the current competitiveness of firms. In the absence of oil, wages across the country will be more equal and, therefore, will more accurately reflect productivity levels in Nigeria.

d) The wage growth of smaller firms remains sluggish, contributing to inequality in Nigeria. These firms are less likely to manage the difficult current "doing business environment", which negatively affects their growth and, therefore, wages paid. Designing effective mechanisms to boost productivity for small and medium-sized enterprises will be critical in raising wages and reducing wage inequalities. These types of policies could be complementary to the implementation of a minimum wage to raise income in small firms. Further, promoting labour mobility could also have an impact in equalising wages across the country. Finally, the greater inequality among services firms compared to manufacturing firms points to the role of unions and the regulation of service sector activities.

e) The large informal sector is normal at this stage of Nigeria's development; however, it does not act as a buffer when the economy is faced with a shock. Thus, without the appropriate mechanisms, a shock will push a major part of the population into hardship. Therefore, an appropriate mechanism is needed. As illustrated by the analysis, traditional recommendations may not isolate the economy from volatility, and thus the government could consider an even more conservative approach in terms of injecting oil revenue into the domestic economy (restrict its use to development projects alone, for example).

More generally, development in a country such as Nigeria is feasible through a consistent policy approach aimed at using oil-revenue to develop its infrastructure. This strategy, when coupled with more exchange rate flexibility, will offer the country the ability to both absorb shocks and support the development of other sectors. These are not simple tasks, and the country has been battling with these issues for the last 50 years. For change to be achieved, it will require established institutions to reform in order to allow policymakers to develop consistent and prudent measures in response to positive oil shocks and to stimulate socio-economic development to avoid perverse effects, such as Dutch Disease. On the other hand, the lack of such stable and efficient institutions in Nigeria have led, and will continue to lead, to poor policies, deepening the negative impacts of resource abundance in the country.

In the Nigerian context, oil inflows have created rent-seeking behaviour among the various stakeholders, resulting in policy inefficiencies. This has led to economic underdevelopment, including the gradual collapse of the agriculture sector and low socio development indicators. Therefore, efficient government is key to transforming the resource curse into a blessing.

7.5 Suggestions for Further Analysis

It is key to acknowledge there are areas of or perspectives regarding the various questions presented here that have not been covered, principally due to data limitation and time constraints. It would be helpful for these to be attended to in the future. Some possibilities for doing so include:

a) It would be interesting to extend the analysis offered in Chapter 4 to the most recent years over which Nigeria has experienced a depreciation of its currency as a result of an oil shock. This will also fully capture the structural change suggested by the GDP rebasing, completed in 2012. Employing a longer time series would have strengthened the analysis in Chapter 4 using the VECM approach. Also, at the microeconomic level, the analysis focused mainly on the formal sector; however, given the size of the informal sector, it would be interesting to study the informal sector and the impact of REER (if any) on this sector, in the future.

b) Concerning Chapter 5, approaching the question from the workers' perspectives could be interesting in the sense of where workers internalise oil revenue in their wage determination. A deeper dive into the dynamics between small, medium and large firms in terms of productivity, as well an investigation into the dynamics between different regions of the country, could also be productive.

c) Incorporating the role of institutions in these different chapters could be of interest for future researchers; they may, for example, wish to include in the wage determination process an analysis of a variable reflecting the lack of transparency of the procurement process. The role of unionised labour requires more attention in the analysis of inequalities. Similarly, in the DGSE model, inefficiency in terms of fiscal policy (i.e. implementation capacity issues) could have been included. The inclusion of this would have affected the spending effect associated with Dutch Disease.

d) Informality in the DGSE model could also have been modelled to ensure more flexibility, thus allowing agents to move from one sector to another or allowing agents to provide services to both the formal and informal sector. Similarly, the formal sector could hire informal labour. Also, explicitly modelling "learning by doing" could add value to the DSGE model presented here. In addition, the fiscal policy presented in my model could be made more complex by incorporating, for example, a permanent-income hypothesis rule.

Overall, this thesis has assessed the predicted impact of Dutch Disease on labour market outcomes in Nigeria using several techniques to best explore the data available. It has provided salient indications and quantified – for the first time – important dimensions of these impacts by using Nigeria as a case study. A number of possible policies that could affect wage and employment level outcomes in the country have been proposed. Some of the evidence presented here, although very specific to the Nigerian context, may provide insights into some of these mechanisms in other developing resource-rich countries that suffer from Dutch Disease and, to a larger extent, from the resource curse.

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